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ABSTRACT

This document contains 27 units to consider for use in a tech prep competency profile for the occupation of electronics technician. All the units listed will not necessarily apply to every situation or tech prep consortium, nor will all the competencies within each unit be appropriate. Several units appear within each specific occupation and would need to only appear once if the user is compiling a cluster of occupations. The first three units are divided into subunits. These units (communications literacy, mathematics literacy, and science literacy) list the competencies for each subunit. The remaining units are divided into competencies, followed by a listing of competency builders. These units are as follows: technology literacy, employability skills, professionalism, teamwork, quality assurance, technical recording and reporting, computer literacy, workplace safety, basic electronics, fundamentals of electronics technology, troubleshooting and repair, microcomputer electronics technology, instrumentation control technology, communications electronics technology, industrial electricity, electrical test and measurement equipment, drafting technology, computer-assisted drafting and design (CADD) fundamentals, intermediate CADD, equipment installation, equipment maintenance, electromechanical technology, hydraulics and pneumatics, and programmable logic controllers. (YLB)

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ED 378 325

ET PREP

"GET SERIOUS... ABOUT SUCCESS"

Electronics Technician

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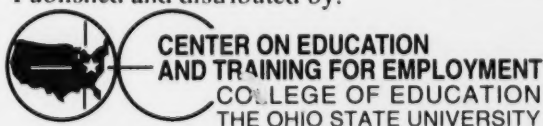
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—NOTICE—

Each Tech-Prep Competency Profile developed should respond to the labor market demands of your Tech Prep Consortium. Therefore, the following pages should be examined carefully before being selected for use in TCP Part I. [See **"The TCP Process" for more information.**] For example, in some cases the number of units far exceeds the amount of content that can be covered within a 4 + 2 TPAD Program. All the units listed in this section will not necessarily apply to your situation, nor will all the competencies within each unit be appropriate. Note that several units appear within each specific occupation and would need to only appear once if you are compiling a cluster of occupations. [See **"TCP Matrix" and "How to Use the TCP Binder" for more information.**]

Unit: Communications Literacy

NOTE: This content was extracted from the 9-12 cluster of Ohio's Model Language Arts Program. Due to statewide initiatives other than Tech Prep, this literacy unit was not altered to meet competency-based criteria. Each literacy unit forms a critical link between academic teachers and members of business, industry, and labor. [See "The TCP Process" for more information.]

Subunit: Reading—Structure Competencies:

- RS1 Exhibit knowledge of language structure
- RS2 Recognize that there may be more than one interpretation of reading selections
- RS3 Recognize various literary devices
- RS4 Recognize and discuss literary elements
- RS5 Develop and use an increasingly sophisticated vocabulary gained through context
- RS6 Apply knowledge of language structure to reading
- RS7 Explain why there may be more than one interpretation of reading selections
- RS8 Recognize effect of literary devices on meaning
- RS9 Analyze author's use of literary elements
- RS10 Recognize relationship of structure to meaning
- RS11 Describe various interpretations and meaning levels in reading selections
- RS12 Characterize author's use of literary devices
- RS13 Characterize use of literary techniques
- RS14 Critique a variety of literature with regard to plot, dialogue, theme, setting, and characterization
- RS15 Apply an expanding vocabulary gained through reading
- RS16 Explain various interpretations and meaning levels in reading selections
- RS17 Analyze use of literary techniques (e.g., extended metaphor, simile, personification, hyperbole, pun, alliteration)
- RS18 Understand use of literary devices (e.g., irony, satire, allegory, onomatopoeia)
- RS19 Analyze and synthesize pieces of literature with regard to plot, dialogue, theme, setting, and characterization

Subunit: Reading—Meaning Construction
Competencies:

- RM1 Demonstrate ability to recognize appropriate pre-reading strategies
- RM2 Describe effectiveness of a reading selection
- RM3 Read to clarify personal thinking and knowledge
- RM4 Support interpretation of text by locating and citing specific information
- RM5 Develop personal response to a variety of literary works
- RM6 Recognize diverse literary interpretations
- RM7 Engage in self-selected reading activities
- RM8 Confirm and extend meaning in reading by researching new concepts and facts
- RM9 Self-monitor and apply corrective strategies when communication has been interrupted or lost
- RM10 Use features of literary genres to extend meaning
- RM11 Assess effectiveness of a selection read
- RM12 Use reading as a possible problem-solving strategy to clarify personal thinking and knowledge
- RM13 Use knowledge of semantic elements (e.g., figurative language, denotation, connotation, dialect) to clarify meaning when reading
- RM14 Predict, recognize, interpret, and analyze themes based on familiarity with author's work
- RM15 Compare and contrast literary genres
- RM16 Assess validity and quality of selection read
- RM17 Clarify meaning when reading
- RM18 Compare personal reaction to critical assessment of a literary selection
- RM19 Assess validity of diverse literary interpretations
- RM20 Use reference books to find, evaluate, and synthesize information
- RM21 Identify tone of a literary work
- RM22 Critique validity of diverse literary interpretations
- RM23 Integrate personal reaction to and critical assessment of a literary selection

**Subunit: Reading—Application
Competencies:**

- RA1 Select and read material for personal enjoyment and information
- RA2 Read a variety of complete, unabridged works
- RA3 Employ various reading strategies according to purpose
- RA4 Participate in selection of books, materials, and topics for literature study groups
- RA5 Develop and apply knowledge of the interrelationship of concepts
- RA6 Read selections from a variety of styles and formats, recognizing that style and format influence meaning
- RA7 Extend value of reading, writing, speaking, viewing, and listening by pursuing, through reading, new concepts and interests developed as a result of these activities
- RA8 Read extensively from a particular author's work and explain elements of author's style

**Subunit: Reading—Multidisciplinary
Competencies:**

- RM1 Connect themes and ideas across disciplines through literature
- RM2 Read to facilitate learning across curriculum
- RM3 Read to develop awareness of human rights and freedom
- RM4 Participate actively in a community of learners
- RM5 Recognize and explain interaction between literature and various cultural domains (e.g., social technological, political, economic)
- RM6 Explore and analyze a variety of cultural elements, attitudes, beliefs, and value structures by men and women of many racial, ethnic, and cultural groups
- RM7 Value thinking and language of others
- RM8 Relate literature to historical period about which or in which it was written
- RM9 Read to facilitate content learning

Subunit: Writing—Structure
Competencies:

- WS1 Develop and expand a repertoire of organizational strategies (e.g., narration, comparison/contrast, and description) through a practice and discussion
- WS2 Clarify word choice according to audience, topic, and purpose
- WS3 Locate and correct errors in usage, spelling, and mechanics using a variety of resources
- WS4 Recognize information gained from primary and secondary sources
- WS5 Develop writing which contains ordered, related, well-developed paragraphs with sentences of varied lengths and patterns
- WS6 Use information from a variety of sources to develop an integrated piece of writing
- WS7 Evaluate and revise writing to focus on such things as audience, tone, and purpose
- WS8 Recognize differences between documentation and reference list styles
- WS9 Develop extended pieces of writing which contain ordered, related, well-developed paragraphs with sentences of varied lengths and patterns
- WS10 Select from a repertoire of organization strategies a pattern appropriate to a topic
- WS11 Synthesize information from a variety of sources
- WS12 Refine word choice and tone according to audience, situation, and purpose
- WS13 Appropriately cite information gained from primary and secondary sources
- WS14 Use style manuals or software to prepare documentation and reference lists
- WS15 Develop effectively organized pieces of expository writing containing strong voice, clear thesis, and well-developed ideas
- WS16 Identify organization patterns appropriate to writing topic
- WS17 Respond to others' suggested revisions to a writing piece

Subunit: Writing—Meaning Construction
Competencies:

- WM1 Demonstrate knowledge of the recursive nature of the writing process by applying it appropriately to various topics, situations, and audiences
- WM2 Develop criteria for writing evaluation using scoring guides and peer/teacher assistance to clarify meaning
- WM3 Respond to others' suggested revisions to a piece of writing
- WM4 Use word processing, graphics, and publishing aids to construct meaning in writing
- WM5 Engage in self-initiated writing activities
- WM6 Incorporate personal criteria with generally accepted standards for writing evaluation
- WM7 Evaluate, analyze, and synthesize information for writing
- WM8 Evaluate own writing using personal and established scoring criteria
- WM9 Assess personal/peer revisions to a writing piece
- WM10 Recognize and refine personal writing styles

**Subunit: Writing—Application
Competencies:**

- WA1 Apply appropriate writing techniques suitable for varied writing tasks
- WA2 Use sentence-combining techniques to improve syntactic fluency and maturity
- WA3 Write in response to prompted and self-selected topics in practical, persuasive, descriptive, narrative, and expository domains
- WA4 Develop personal voice in writing
- WA5 Consider audience and purpose for writing
- WA6 Develop criteria for selection and potential development of topic
- WA7 Write in a journal or learning log to clarify personal thinking and knowledge
- WA8 Apply an expanding vocabulary gained through writing
- WA9 Make judicious use of reference sources (e.g., dictionary, thesaurus, on-line data base, encyclopedia)
- WA10 Demonstrate an appreciation for aesthetically pleasing language through word choice and style
- WA11 Apply revising and editing strategies needed for writing task
- WA12 Vary sentence lengths and patterns
- WA13 Refine personal voice in writing
- WA14 Vary styles and formats for intended purpose and audience
- WA15 Apply criteria for selection and development of topic
- WA16 Participate in peer review of writing in progress
- WA17 Use transitions between sentences, ideas, and paragraphs in writing
- WA18 Revise and edit papers extensively in preparation for presentation/publication
- WA19 Develop a variety of genres
- WA20 Focus writing and tone on such elements as audience, situation, and purpose
- WA21 Develop topic fully and appropriately
- WA22 Use writing process to clarify personal thinking and knowledge
- WA23 Apply appropriate recursive writing process as suggested by writing task and writer's process
- WA24 Develop an extended piece of writing
- WA25 Revise writing and tone to assure focus on such elements as audience, situation, and purpose
- WA26 Use writing process to write reflectively

**Subunit: Writing—Multidisciplinary
Competencies:**

- WM1 Use writing process for learning across curriculum
- WM2 Use writing process to demonstrate knowledge of need for human rights and freedom
- WM3 Value and apply collaborative skills in writing process
- WM4 Write in response to reading, speaking, viewing, and listening
- WM5 Use multidisciplinary resources in writing projects
- WM6 Use writing process to facilitate learning across curriculum
- WM7 Recognize value of and engage in collaboration in writing process
- WM8 Use communication processes to develop a published writing piece in collaboration with others
- WM9 Record experiences and observations related to content learning
- WM10 Apply collaborative skills in writing process
- WM11 Write collaboratively with peers
- WM12 Use cross-disciplinary resources in writing projects

**Subunit: Listening/Visual Literacy—Structure
Competencies:**

- LS1 Listen to and view a wide variety of genres
- LS2 Become aware of an author's style through listening and viewing a variety of works
- LS3 Recognize correct and appropriate grammar, diction, and syntax
- LS4 Expand vocabulary through listening to and viewing varied media
- LS5 Recognize beauty of language
- LS6 Enhance recognition of an author's style through listening and viewing a variety of works
- LS7 Recognize use and misuse of language in media
- LS8 Refine knowledge of style through listening and viewing multiple works by the same author
- LS9 Expand and refine grammar, diction, and syntax through listening
- LS10 Compare authors' styles through viewing and listening to their works
- LS11 Expand knowledge of complex grammar, diction, and syntax issues

Subunit: Listening/Visual Literacy—Meaning Construction Competencies:

- LM1 Develop critical thinking skills necessary to evaluate media and assess oral presentations
- LM2 Compare new oral texts to past experiences and knowledge in order to enhance comprehension
- LM3 Recognize how rhythmic patterns, silence, and cadences enhance quality of speech and literature
- LM4 Focus listening and viewing on themes and/or plots
- LM5 Gather information from listening and viewing experiences to enhance research
- LM6 Use critical thinking skills to evaluate media and oral presentations
- LM7 Use prior knowledge and experiences to facilitate comprehension of new oral texts
- LM8 Identify rhythmic and time patterns in speech and literature
- LM9 Identify and analyze themes and/or plots when listening and viewing
- LM10 Use information gathered from listening and viewing experiences to expand research
- LM11 Enhance use of critical thinking skills to evaluate media and oral presentations
- LM12 Consider prior knowledge and experiences when attempting to understand the meaning of new texts
- LM13 Appreciate rhythmic and time patterns of speech and literature
- LM14 Select viewing and listening materials to support written text
- LM15 Evaluate media and oral presentations analytically and critically
- LM16 Organize prior knowledge and experiences to comprehend new texts
- LM17 Organize and use viewing and listening materials to support written text

Subunit: Listening/Visual Literacy—Application Competencies:

- LA1 Listen attentively during oral reading
- LA2 Use media as stimuli for learning and thinking
- LA3 Develop knowledge of structure through art, music, and literature
- LA4 Use electronic media to enhance and highlight language learning
- LA5 Listen and view for entertainment and enjoyment
- LA6 Use technology and other media as means of expressing ideas

Subunit: Listening/Visual Literacy—Multidisciplinary Competencies:

- LM1 Facilitate learning across curriculum through critical listening and viewing
- LM2 Engage in individual, small-group, and whole-group listening and viewing activities
- LM3 Develop language arts (e.g., viewing, listening) projects collaboratively
- LM4 Investigate language and cultural differences through listening and viewing activities
- LM5 Participate in a community of learners through productive listening

Subunit: Oral Communication—Structure Competencies:

- OS1 Refine oral communication skills
- OS2 Demonstrate knowledge of grammar, usage, and syntax when presenting
- OS3 Select topics and vocabulary suitable to audience
- OS4 Organize notes and ideas for speaking
- OS5 Use language imaginatively
- OS6 Modulate voice to meaning when interpreting literature orally
- OS7 Organize notes and ideas for formal, semiformal and informal presentations of information
- OS8 Refine speaking techniques for formal, semiformal, and informal settings
- OS9 Develop repertoire of organizational strategies for presenting information orally
- OS10 Expand vocabulary to fit topic
- OS11 Select topics suitable to audience, situation, and purpose
- OS12 Select appropriate strategies when organizing notes and ideas for speaking

**Subunit: Oral Communications—Meaning Construction
Competencies:**

- OM1 Make connections between prior knowledge and new information for oral presentations
- OM2 Participate in informal speaking activities
- OM3 Use interviewing techniques to gather information
- OM4 Communicate orally to entertain and to inform
- OM5 Participate in group communication activities
- OM6 Take and organize notes when preparing speech/presentation
- OM7 Interpret texts orally to illustrate meaning
- OM8 Respond to needs of various audiences
- OM9 Gather and assess information for speaking
- OM10 Communicate orally to inform and persuade
- OM11 Prepare and deliver formal speech/presentation
- OM12 Participate in a variety of oral interpretations
- OM13 Assess needs of audience and adjust language and presentation according to their knowledge
- OM14 Analyze and synthesize information for speaking
- OM15 Describe effectiveness of literary selection
- OM16 Describe topic or idea in order to clarify personal/audience thinking
- OM17 Analyze and synthesize information gathered from a variety of sources for speaking
- OM18 Describe validity and/or quality of a literary selection and justify selection
- OM19 Interpret orally a variety of literature
- OM20 Describe topic or idea to clarify meaning for others

**Subunit: Oral Communication—Application
Competencies:**

- OA1 Become proficient at using interviewing techniques
- OA2 Give an oral interpretation for a specific audience
- OA3 Develop and apply oral communication skills for cooperative/collaborative learning
- OA4 Use oral communication for a variety of purposes and audiences (e.g., negotiations, book reviews, rationales)
- OA5 Develop and apply decision-making strategies
- OA6 Practice interviewing techniques
- OA7 Apply interviewing techniques to purposeful interviews
- OA8 Focus oral interpretation on a specific audience

Subunit: Oral Communications—Multidisciplinary Competencies:

- OM1 Value thinking and language of others
- OM2 Develop oral projects collaboratively
- OM3 Be involved in individual, small-group, and whole-group language activities
- OM4 Participate actively in a community of learners
- OM5 Investigate language and cultural differences through oral language activities

Unit: Mathematics Literacy

NOTE: This content was extracted from the 9-12 cluster of Ohio's Model Mathematics Program. Due to statewide initiatives other than Tech Prep, this literacy unit was not altered to meet competency-based criteria. Each literacy unit forms a critical link between academic teachers and members of business, industry, and labor. [See "The TCP Process" for more information.]

Subunit: Numbers and Number Relations Competencies:

- NR1 Compare, order, and determine equivalence of real numbers
- NR2 Estimate answers, compute, and solve problems involving real numbers
- NR3 Compare and contrast real number system, rational number system, and whole number system
- NR4 Extend knowledge to complex number system and develop facility with its operation

Subunit: Measurement Competencies:

- M1 Estimate and use measurements
- M2 Understand need for measurement and probability that any measurement is accurate to some designated specification
- M3 Understand and apply measurements related to power and work
- M4 Understand and apply measurement concepts of distance-rate-time problems and acceleration problems
- M5 Use real experiments to investigate elasticity, heat, sound, electricity, magnetism, light, acceleration, velocity, energy, and gravity
- M6 Use real-world problem situations involving mass and weight
- M7 Use real-world problem situations involving simple harmonic motion
- M8 Establish ratios with and without common units
- M9 Construct and interpret maps, tables, charts, and graphs as they relate to real-world mathematics
- M10 Understand and solve rate-change problems
- M11 Understand and solve right triangle relationships as they relate to measurement, specifically to Pythagorean theorem
- M12 Graph and interpret ordered pairs
- M13 Compute total sales from a variety of items
- M14 Comprehend and compute rates of growth or decay
- M15 Comprehend, compute, and interpret real problems involving annuities

Subunit: Measurement (continued)**Competencies:**

- M16 Develop an ability to identify real problems and provide possible solutions
- M17 Express and apply different types of measurement scales
- M18 Identify area and volume

Subunit: Estimation and Mental Computation**Competencies:**

- E1 Use estimation to eliminate choices in multiple-choice tests
- E2 Use estimation to determine reasonableness of problem situations in a wide variety of applications
- E3 Estimate shape of graphs of various functions and algebraic expressions
- E4 Use mental computation when computer and calculator are inappropriate

Subunit: Data Analysis and Probability**Competencies:**

- D1 Organize data into tables, charts, and graphs
- D2 Understand and apply measures of central tendency, variability, and correlation
- D3 Use curve fitting to predict from data
- D4 Use experimental or theoretical probability, as appropriate, to represent and solve problems involving uncertainty
- D5 Use computer simulations and random number generators to estimate probabilities
- D6 Test hypotheses using appropriate statistics
- D7 Read, interpret, and use tables, charts, and graphs to identify patterns, note trends, draw conclusions, and make predictions
- D8 Identify probabilities of events involving unbiased objects
- D9 Use sampling and recognize its role in statistical claims
- D10 Design a statistical experiment to study problem, conduct experiment, and interpret and communicate outcomes
- D11 Describe normal curve in general terms and use its properties
- D12 Create and interpret discrete probability distributions
- D13 Understand concept of random variable
- D14 Apply concept of random variable to generate and interpret probability distributions, including binomial, uniform, and chi square

**Subunit: Algebra
Competencies:**

- A1 Describe problem situations by using and relating numerical, symbolic, and graphical representations
- A2 Use language and notation of functions in symbolic and graphing settings
- A3 Recognize and use equivalent zeros of a function, roots and the solution of an equation in terms of graphical and symbolic representations
- A4 Describe and use logic of equivalence in working with equations, inequalities, and functions
- A5 Develop graphical techniques of solution for problem situations involving functions
- A6 Explore and describe characterizing features of functions
- A7 Make arguments and proofs in algebraic settings
- A8 Factor difference of two squares
- A9 Identify slope, midpoint, and distance
- A10 Explore and combine rational functions
- A11 Explore factoring techniques
- A12 Solve quadratic equations by factoring and formula
- A13 Set up and solve linear equations
- A14 Solve systems of linear equations with two variables
- A15 Describe geometric situations and phenomena using variables, equations, and functions
- A16 Describe measures of central tendency, mean, median, mode, and variance algebraically and graphically
- A17 Represent inequalities on number line and in coordinate plane
- A18 Use coordinate arguments in making geometric proofs
- A19 Symbolize transformations of figures and graphs
- A20 Explore geometric basis for functions of trigonometry
- A21 Graph linear functions
- A22 Develop and use vectors to represent direction and magnitude including operations
- A23 Use polar and parametric equations to describe, graph, and solve problem situations
- A24 Represent sequences and series as functions both algebraically and graphically
- A25 Explore recursive functions and procedures using spreadsheets, other computer utilities, and appropriate notions
- A26 Describe and solve algebraic situations with matrices
- A27 Describe and use inverse relationship between functions including exponential and logarithmic

Subunit: Algebra (continued)**Competencies:**

- A28 Analyze and describe errors and error sources that can be made when using computers and calculators to solve problems
- A29 Decide whether problem situation is best solved using computer, calculator, paper and pencil, or mental arithmetic/estimation techniques
- A30 Explore relationships between complex numbers and vectors
- A31 Make arguments concerning limits, convergence and divergence in context involving sequences, series, and other types of functions
- A32 Represent transformations in plane with matrices
- A33 Contrast and compare algebra's of rational, real, and complex numbers with characteristics of a matrix algebra system
- A34 Construct polynomial approximations of a function over specified intervals of convergence
- A35 Examine complex numbers as zeros of functions
- A36 Translate verbal statements into symbolic language
- A37 Simplify algebraic expressions
- A38 Use laws and exponents (including scientific notation)
- A39 Expand and extend idea of vectors and linear algebra to higher dimensional situations
- A40 Use the idea of independent basis elements for a vector space and associated fundamental concepts of finite dimensional linear algebra
- A41 Develop and communicate arguments about limit situations
- A42 Use matrices to describe and apply transformations
- A43 Develop and use polar and parametric equations to represent problem situations
- A44 Explore proofs by mathematical induction

Subunit: Geometry
Competencies:

- G1 Create and interpret drawings of three-dimensional objects
- G2 Represent problem situations with geometric models and apply properties of figures
- G3 Apply Pythagorean theorem
- G4 Demonstrate knowledge of angles and parallel and perpendicular lines
- G5 Explore inductive and deductive reasoning through applications to various subject areas
- G6 Translate between synthetic and coordinate representations
- G7 Identify congruent and similar figures using transformation with computer programs
- G8 Deduce properties of figures using transformations and coordinates
- G9 Use deductive reasoning
- G10 Explore compass and straightedge constructions in context of geometric theorems
- G11 Demonstrate knowledge of and ability to use proof
- G12 Use variety of proof techniques (e.g., synthetic, transformational, and coordinate)
- G13 Use variety of proof formats, including T-proof (i.e., two-column) and paragraph proof
- G14 Explore different proof strategies
- G15 Investigate different proofs of theorems
- G16 Develop knowledge of an axiomatic system
- G17 Apply transformations and coordinates in problem solving
- G18 Represent problem situations with geometric models and apply properties of figures
- G19 Deduce properties of figures using vectors
- G20 Analyze properties of Euclidean transformations and relate translations to vectors
- G21 Apply vectors in problem solving
- G22 Develop further knowledge of axiomatic systems by investigating and comparing various geometry's

Subunit: Patterns, Relations, and Functions
Competencies:

- P1 Model real-world phenomena with polynomial and exponential functions
- P2 Explore relationship between zeros and intercepts of functions
- P3 Translate among tables, algebraic expressions, and graphs of functions
- P4 Use graphing calculator or computer to generate graph of a function
- P5 Explore relationship between a linear function and its inverse
- P6 Describe and use characteristics of polynomial functions in problem-solving situations
- P7 Explore conic sections and graph using graphing calculator or computer
- P8 Apply trigonometric functions to problem situations involving triangles
- P9 Discover relationships between algebraic description, kind, and properties of conic
- P10 Explore periodic real-world phenomena using sine and cosine functions
- P11 Analyze effects of parameter changes on graphs
- P12 Use graphing calculator or computer to graph functions
- P13 Develop an knowledge of rational and transcendental functions
- P14 Understand connections between trigonometric and circular functions
- P15 Use circular functions to model periodic real-world functions
- P16 Solve trigonometric equations and verify trigonometric identities
- P17 Understand connections between trigonometric, exponential, and logarithmic functions and polar coordinates, complex numbers, and series
- P18 Model real-world phenomena with a variety of functions
- P19 Graph using polar coordinates
- P20 Explore graphs in three dimensions
- P21 Explore functions of several variables
- P22 Explore recursive functions using spreadsheets and/or programming languages

Unit: Science Literacy

NOTE: This content was extracted from the 9-12 cluster of Ohio's Draft Model Science Program. Due to statewide initiatives other than Tech Prep, this literacy unit was not altered to meet competency-based criteria. Each literacy unit forms a critical link between academic teachers and members of business, industry, and labor. [See "The TCP Process" for more information.]

Subunit: Scientific Inquiry Competencies:

- Q1 Check the appropriateness and accuracy of measures and computations using various strategies (e.g., estimations, unit analysis, determination of significant figures)
- Q2 Use ratios, proportions, and probabilities in appropriate problem situations
- Q3 Translate information from and represent information in various forms with equal ease (e.g., tables, charts, graphs, diagrams, geometric figures)
- Q4 Use existing algebraic formulas and create new ones in appropriate problem-solving situations
- Q5 Estimate and justify probabilities of outcomes of familiar situations based on experimentation and other strategies
- Q6 Invent apparatus and mechanical tools needed to perform unique tasks in various situations
- Q7 Identify, compare, and contrast different modes of inquiry, habits of mind, and attitudes and dispositions
- Q8 Design investigations that are safe and ethical (i.e., obtain consent and inform others of potential outcomes, risks and benefits, and show evidence of concern for human health and safety, concern for non-human species)
- Q9 Make and read scale drawings, maps, models, and other representations to aid planning and understanding
- Q10 Seek elaboration and justification of data and ideas, and reflect on alternative interpretations of the information
- Q11 Use appropriate units for counts and measures
- Q12 Create and use databases (electronic and other) to collect, organize, and verify data and observations
- Q13 Design and conduct investigations with multiple variables
- Q14 Communicate the results of investigations clearly in a variety of situations

Subunit: Scientific Inquiry (continued)**Competencies:**

- Q15 Examine relationships in nature, offer alternative explanations for the observations, and collect evidence that can be used to help judge among explanations
- Q16 Trace the development (e.g., history, controversy, and ramifications) of various theories, focusing on supporting evidence and modification with new evidence
- Q17 Select, invent, and use tools, including analog and digital instruments, to make and record direct measurements
- Q18 Observe and document events and characteristics of complex systems
- Q19 Explain the influence of perspective (e.g., spatial, temporal, and social) on observation and subsequent interpretations
- Q20 Create multiple representations of the same data using a variety of symbols, descriptive languages, mathematical concepts, and graphic techniques
- Q21 Generate testable hypotheses for observations of complex systems and interactions
- Q22 Document potentially hazardous conditions and associated risks in selected homes and public areas
- Q23 Participate in public debates, relying on documented and verified data to construct and represent a position on scientific issues
- Q24 Construct and test models of physical, biological, social, and geological systems
- Q25 Read, verify, debate, and, where necessary, refute research published in popular or technical journals of science (e.g., *Discover*, *Omni*, *Popular Mechanics*)
- Q26 Explore discrepant events and develop and test explanations of what was observed
- Q27 Conduct theory-based research using surveys, observational instruments, and other methods
- Q28 Modify personal opinions, interpretations, explanations, and conclusions based on new information
- Q29 Analyze error and develop explanations in various domains
- Q30 Formulate taxonomic schemes based upon multivariate models that help to explain similarities and differences in form, distribution, behavior, survival, and origin of objects and organisms
- Q31 Demonstrate various logical connections between related concepts (e.g., entropy, conservation of energy)
- Q32 Account for discrepancies between theories and observations
- Q33 Analyze the changes within a system when inputs, outputs, and interactions are altered

Subunit: Scientific Inquiry (continued)**Competencies:**

- Q34 Create, standardize, and document procedures
- Q35 Determine the sources of significant disparities between the predicted and recorded results and change research procedures to minimize disparities
- Q36 Research, locate, and propose applications for abstract patterns (e.g., fractals, Fibonacci sequences, string theory, orbitals)
- Q37 Recognize and utilize classification systems for particles, elements, compounds, phenomena, organisms, and others for exploring and predicting properties and behaviors
- Q38 Suggest and defend alternative experimental designs and data explanations (e.g., sampling, controls, safeguards)
- Q39 Recognize and communicate differences between questions that can be investigated in a scientific way and those that rely on other ways of knowing
- Q40 Draw conclusions based on the relationships among data analysis, experimental design, and possible models and theories
- Q41 Suggest new questions as a result of reflection on and discussions about their own scientific investigations
- Q42 Investigate, assess, and comment on strengths and weakness of the descriptive and predictive powers of science
- Q43 Create new information from representations of data in a variety of forms (e.g., symbols, descriptive languages, graphic formats) utilizing a variety of techniques (e.g., interpolations, extrapolations, linear regressions, central tendencies, correlation's)

**Subunit: Scientific Knowledge
Competencies:**

- K1 Investigate various types of dynamic equilibrium (e.g., biological, geological, mechanical, chemical)
- K2 Investigate the relationship between the rates of energy exchange and the relative energy level of components with systems (e.g., tropic levels of ecosystems, osmosis, rate of heating and cooling, storms)
- K3 Investigate patterns in the natural world (e.g., heredity, crystalline structures, population and resource distributions, diffraction, dispersion, polarization)
- K4 Investigate models and theories that help to explain the interactions of components in systems (e.g., conservation of mass, energy, and momentum; food webs; natural selection; entropy; plate tectonics; chaos; relativity; social-psychology)
- K5 Investigate degrees of kinship among organisms and groups of organisms
- K6 Investigate the limits of the definition of life, and investigate organisms and physical systems that exist at or near these limits (e.g. viruses, quarks, black holes)
- K7 Investigate estimates and measurements of a wide range of distances and rates of change
- K8 Investigate the historical development of theories of change over time (e.g., natural selection, continental drift, the big bang, geologic change)
- K9 Investigate physical and chemical changes in living and non-living systems (e.g., photosynthesis, weathering processes, glaciation, thermal effects of materials, energy cells)
- K10 Investigate simulations of nuclear change (e.g., radioactivity, half life, carbon dating)
- K11 Investigate conservation principles associated with physical, chemical, and nuclear changes
- K12 Formulate descriptions of the impacts of various forms of mechanical and electromagnetic waves on various organisms on each other over time
- K13 Formulate models and hypotheses for patterns in the natural world (e.g., earth structures, transportation systems, migrations, communications, constellations)
- K14 Formulate explanations for the influences of objects and organisms on each other over time
- K15 Formulate and interpret explanations for change phenomena (e.g., mass extinction's, stellar evolution, punctuated equilibrium, molecular synthesis)

Subunit: Scientific Knowledge (continued)**Competencies:**

- K16 Formulate and interpret explanations for the magnitudes of diversity at different periods of geologic time (e.g., mutation, global cataclysms, continental drift, competition, mass extinction's)
- K17 Formulate interpretations of the structure, function, and diversity in a variety of organisms and physical systems (e.g., DNA and RNA variants, nucleons, interaction particles)
- K18 Formulate understandings of geologic time (e.g., millennia, periods, epochs)
- K19 Formulate an understanding of the historical development of the model of the universe
- K20 Formulate explanations and representations of the production, transmission, and conservation of energy in biological and physical systems (e.g., weather, volcanism, earthquakes, electricity, magnetism, cellular respiration)
- K21 Formulate models and hypotheses about patterns in the natural world (e.g., social behavior, molecular structure, energy transformation, entropy, randomness, aging, chaos, hormonal cycles)
- K22 Formulate interpretations of the relationship between energy exchange and the interfaces between components within systems
- K23a Formulate estimations for the range of energies within and between various phenomena (e.g., thermal, electromagnetic, thermonuclear, chemical, electrical)
- K23b Formulate explanations for the historical development of descriptions of motions interactions and transformations of matter and energy (e.g., classical Newtonian mechanics, special and general relativity, chaos)
- K24 Formulate models that can be used to describe fundamental molecular interactions in living and non-living systems (e.g., cell membranes, semiconductors).
- K25 Formulate an understanding of the degree of relationship among organisms and objects based on molecular structure (e.g., proteins, nucleic acids)
- K26 Formulate hypotheses and models that may account for observable events (e.g., electricity and magnetism, gravitation, atoms, bonding, chemical reactions, quantum effects, energy flow on biological systems, predator-prey relationships)
- K27 Formulate models and hypotheses about change over time (e.g., natural selection, speciation, punctuated equilibrium, phyletic gradualism, stellar evolution, plate tectonics, radioactive decay, quantum mechanical theory)

Subunit: Scientific Knowledge (continued)
Competencies:

- K28 Formulate lists of limitations and propose refinements of standard classification systems (e.g., periodic table, IUPAC, Linnean, standard model)
- K29 Formulate specific cases of limitations and possible exceptions of theories and principles regarding the interactions of moving objects and organisms (e.g., fluid flow in vessels, motion near the speed of light, Heisenberg uncertainty principle, meteorological prediction, local variation and diversity, predicting earthquakes, energy transport in cellular respiration)
- K30 Formulate plans and contingencies that can be used to accommodate for changes to and stresses on systems (e.g., wildlife and habitat management, corrosion prevention, noise abatement, structure design)
- K31 Formulate models of molecular, atomic, ionic, and subatomic structures and the physical and biological implications of these structures (e.g., genes, nucleons, quarks)
- K32 Formulate estimates for a wide range of measurements and scales (e.g., angstroms to light years)
- K33 Formulate and interpret representations of time from origin to present accounting for phenomena of scale (e.g., smoothness, punctuation's, chaos)
- K34 Formulate interpretations of the historical development of various theories of possible causes of diversity among physical and biological phenomena (e.g., the works of Aristotle, Mendel, Darwin, McClintock)
- K35 Formulate models and hypotheses that can be used to explain the interactions of components within technological and ecological systems

Subunit: Conditions for Learning Science Competencies:

- C1 Participate actively in dialogue about and resolution of community issues
- C2 Assess information from various countries in the original language or translated form to ascertain the perspectives of many cultures
- C3 Analyze the scientific ideas presented in science fiction stories and films
- C4 Perform and repeat investigations to verify data, determine regularity, and reduce the impact of experimental error
- C5 Present the results of investigations in a variety of forums
- C6 Contribute to the decisions regarding topics for investigation
- C7 Use various creative means to communicate interpretations of scientific ideas, concepts, phenomena, and events
- C8 Consider the scientific thinking and language of others
- C9 Individually and collaboratively produce clearly written representations of investigative results
- C10 Fulfill responsibilities as part of a research group
- C11 Select and utilize resources by various criteria (e.g., efficiency, effectiveness, health, safety) that are appropriate to the investigations being conducted by groups
- C12 Present persuasive argument based on the scientific aspects of controversial issues
- C13 Collect, store, retrieve, and manipulate information with available technologies that may range from hand processes up through computer applications
- C14 Investigate social issues with a scientific perspective (e.g., human rights, wellness, economics, futurism, environmental ethics)
- C15 Keep journals of observations and inferences made over an extended period of time and reflecting upon the impact of these recorded ideas on their thinking and actions
- C16 Examine the intellect, perspectives, and ethics of notable scientists
- C17 Collect and analyze observations made over extended periods of time and compare these to scientific theories
- C18 Create presentations of scientific understandings using diverse modes of expressions
- C19 Conduct formal scientific debates in the classroom
- C20 Wonder about the likelihood of events that may occur by chance or coincidence
- C21 Plan and conduct field trips and experiences for small and large groups
- C22 Analyze the historical context which leads to and has led to scientific theories

Subunit: Conditions for Learning Science (continued)
Competencies:

- C23 Seek information on topics of personal scientific interest from a variety of sources
- C24 Conduct learner-developed investigations independently and collaboratively over periods of week and months
- C25 Listen attentively and critically to presentations of scientific information made by others
- C26 Conduct analyses of propaganda related to scientific issues
- C27 Perform investigations that require observations over varying periods of time
- C28 Experience scientific concepts as interpreted by other cultures through multimedia and local and global specialists
- C29 Access appropriate technology to perform complicated, time-consuming tasks
- C30 Relate historical accounts of science to the cultural context in which they were written
- C31 Work as a contributing member of a collaborative research group
- C32 Examine the influences of social and political structures and realities that contribute to inquiry about scientific issues
- C33 Use technology (e.g., desktop publishing, teleconferencing, networking) to communicate scientific ideas
- C34 Explore and analyze a variety of perspectives on science (e.g., works by men and women of many racial, ethnic, and cultural groups)
- C35 Lead groups of learners of various ages in designing, planning, and conducting science activities
- C36 Respect the scientific thinking of others and self
- C37 Recognize and contrast different epistemologies
- C38 Develop possible courses of action in response to scientific issues of local and global concern
- C39 Determine the validity of research conclusions in relation to the design, performance, and results
- C40 Develop multimedia presentations of group and individual research projects and investigations appropriate for a variety of audiences and forums
- C41 Produce interesting and scientifically correct stories and present them using various modes of expression
- C42 Reflect on the ideas and content found in their own journal records
- C43 Examine ambiguous results and formulate explanations
- C44 Recognize and synthesize the contributions to scientific thought of individuals from many cultures

Subunit: Conditions for Learning Science (continued)
Competencies:

- C45 Construct models and simulations of the component structures and functions of living and non-living entities
- C46 Lead multi-age groups in the examination of and planned resolution for scientific issues
- C47 Recognize and choose members of research teams based upon the merit of their ideas and skills
- C48 Construct a portfolio of products, documentation, and self-evaluations of his/her own abilities, skills, and experiences
- C49 Synthesize scientific information from a variety of sources
- C50 Evaluate and prioritize scientific issues based upon risk-benefit analyses
- C51 Refining scientific skills from a variety of experiences

**Subunit: Applications for Science Learning
Competencies:**

- A1 Answer student-determined questions by designing databases and drawing inferences from the analyses of the information in these data bases
- A2 Make personal behavior decisions by interpreting information that has a scientific basis
- A3 Propose courses of action that will validate and demonstrate personal understandings of scientific principles
- A4 Guide other learners in their understanding of the interactions of technologies and society at various periods in time
- A5 Promote and carry out practices that contribute to a sustainable environment
- A6 Study and propose improvements in public services and systems in their community
- A7 Choose consumer materials utilizing personal and environmental risk and benefit information
- A8 Make inferences and draw conclusions using databases, spreadsheets, and other technologies
- A9 Do simple trouble-shooting on common electrical and mechanical systems, identifying and eliminating possible causes of malfunctions
- A10 Construct devices that perform simple, repetitive actions
- A11 Investigate the functionality of various geometric shapes in the natural world and the designed world (e.g., translations from spherical to plane representations cause distortions, triangular shapes contribute to rigidity and stability in structures, round shapes minimize boundary for a given capacity)
- A12 Make decisions regarding personal and public health
- A13 Evaluate the social and ecological risks and benefits resulting from the use of various consumer products
- A14 Analyze the contributions of advances in technology through history to his/her everyday life
- A15 Identify and reduce risks and threats to a sustainable environment
- A16 Extend the limits of human capabilities using technological enhancements
- A17 Use and recognize various propaganda techniques
- A18 Solve unique problems using the results of systematic analyses
- A19 Choose everyday consumer products that utilize recent innovation and pass appropriate performance criteria
- A20 Refine personal career interests through investigations of the diversity of manufacturing, research, service, and invention processes

Subunit: Applications for Science Learning (continued)
Competencies:

- A21 Predict and investigate the working of toys and tools while controlling and manipulating variables (e.g., friction, gravity, forces)
- A22 Write, follow, modify, and extend instructions (e.g., equations, algorithms, formulas, flow diagrams, illustrations)
- A23 Create products, make inferences, and draw conclusions using databases, spreadsheets, and other technologies
- A24 Predict various scenarios and propose solutions to community issues using scientific information (e.g., actuarial tables, census data, topographic maps, incidence data, climatic data)
- A25 Use scientific evidence to consider options and formulate positions about the health and safety of others and him/herself
- A26 Search for, use, create, and store objects and information using various strategies and methods of organization and access
- A27 Research and write environmental impact statements of his/her own design
- A28 Compare school-based science perspectives with those gained through cutting-edge technological applications
- A29 Design management plans for natural and human-altered environments (e.g., woodlots, patios, lots, lawns, farmlands, forests)
- A30 Refine personal career interests
- A31 Promote public awareness of the interaction of technology with social issues
- A32 Advocate and propose courses of action for local and global scientific issues using global networks
- A33 Use appropriate technologies to prepare and present the findings of investigations incorporating tables, graphs, diagrams, and text
- A34 Make informed consumer choices by evaluating and prioritizing information, evidence, and strategies
- A35 Develop an informed point-of-view that allows for validation or refutation of the scientific statements and claims of advocated before pursuing courses of action (e.g., contributing support, signing petitions, casting votes)
- A36 Differentiate between observations and inferences in the exploration of evidence related to personal, scientific, and community issues
- A37 Develop and write environmental impact and safety and hygiene management plans
- A38 Use technology to collect, analyze, and communicate information (e.g., electronic networks, desktop publishing, remote sensing, graphing calculators, satellite telemetry, and others)
- A39 Design, construct, and market inventions

Unit: Technology Literacy

NOTE: Over 500 Ohio business, industry, and labor representatives examined, altered, and then verified the content for this unit during the TCP Process. The original content was extracted from the Report of the Task Force on Technology Competence—Learner Goals for All Minnesotans, published by the Minnesota State Council on Vocational Technical Education. The Technology Literacy unit forms a critical link between all teachers and stresses the importance of technological impact on teaching and learning. [See "The TCP Process" for more information.]

Competencies:

- T1 Demonstrate a systems view of technology based on the interdependence of social, political, economic, and ecological systems
- T2 Assess the career, family, and personal development implications of technological change
- T3 Demonstrate continuous learning via technology
- T4 Demonstrate global appreciation for technology's potential effects on cultures, geographic areas, and the environment
- T5 Apply historical perspective on technology to the development and use of new technologies
- T6 Apply diverse technologies to store, access, process, create, and communicate information needed to solve problems
- T7 Apply legal principles and ethical conduct to the use of technology
- T8 Demonstrate competency in mathematics, science, social sciences, communication, and computer skills through the analysis, design, and evaluation of technological systems
- T9 Analyze the potential of alternative technological systems to solve problems and/or to extend human capabilities
- T10 Use a variety of tools, materials, and equipment in solving problems and extending human capabilities
- T11 Assess risks and benefits of technological developments from an ecological, economic, social, and political perspective
- T12 Value human diversity as part of a team in suggesting, designing, and testing solutions to technological problems

Unit: Employability Skills

Competency: Develop a career plan

Competency Builders:

Identify current interests and aptitudes

Identify common barriers to employment

Describe strategies to overcome employment barriers

Locate resources for finding employment

Research job trends

Identify career options

Identify advantages and disadvantages of career options (in addition to other than monetary)

Identify job requirements

Investigate education/training opportunities

Evaluate personal strengths and weaknesses

Competency: Prepare for employment

Competency Builders:

Identify traditional and non-traditional employment sources
 Identify present and future employment opportunities (by geographic location)
 Research job opportunities, including non-traditional careers
 Compare salary ranges and benefit packages
 Compile occupational profile
 Identify rights and responsibilities of equal employment opportunity laws
 Design resume and cover letter
 Target resume
 Secure references
 Investigate generic and specific employment tests (e.g., civil service exam; drug screening)
 Use follow-up techniques to enhance employment potential
 Demonstrate legible written communication skills using correct grammar, spelling, punctuation, and concise wording
 Describe methods for handling illegal questions on job application forms and during interviews
 Write letter of application
 Research prospective employer and services performed
 Explain critical importance of personal appearance, hygiene, and demeanor
 Interpret job description
 Demonstrate appropriate interview question and answer techniques
 Demonstrate methods for handling difficult interview questions
 Evaluate job offers
 Write letter of acceptance
 Write letter of declination
 Demonstrate good listening skills
 Ask for the job tactfully
 Participate in extracurricular activities (e.g., student government, community projects,)

Competency: Evaluate the importance of self-esteem as an employability skill

Competency Builders:

Identify factors that affect self-esteem
 Compare effects of low self-esteem and high self-esteem
 Identify strategies to promote positive self-esteem

Competency: Demonstrate job retention skills**Competency Builders:**

Identify employer expectations regarding job performance, work habits, attitudes, personal appearance, and hygiene
Exhibit appropriate work habits and attitude
Demonstrate ability to set priorities
Identify behaviors to establish successful working relationships
Identify alternatives for dealing with harassment, bias, and discrimination based on race, color, national origin, sex, religion, handicap, or age
Identify opportunities for advancement
List reasons for termination
List consequences of being absent frequently from job
List consequences of frequently arriving late for work
Demonstrate interpersonal relations skills (i.e., verbal and written)
Demonstrate negotiation skills
Demonstrate teamwork
Follow chain-of-command
Exhibit appropriate job dedication

Competency: Demonstrate knowledge of work ethic**Competency Builders:**

Define work ethic
Identify factors that influence work ethic
Differentiate law and ethics
Describe how personal values are reflected in work ethic
Describe how interactions in the workplace affect personal work ethic
Describe how life changes affect personal work ethic

Competency: Exhibit appropriate work ethic**Competency Builders:**

- Use time-management techniques
- Avoid personal activity during work hours
- Attend work as scheduled
- Adhere to company and/or governmental policies, procedures, rules, and regulations
- Exercise confidentiality
- Demonstrate appropriate human relations skills
- Adhere to rules of conduct
- Accept constructive criticism
- Offer constructive criticism
- Take pride in work
- Resolve conflict
- Manage stress
- Avoid sexual connotations and harassment
- Adjust to changes in the workplace
- Demonstrate punctuality
- Assume responsibility for personal decisions and actions
- Take responsibility for assignments
- Follow chain-of-command

Competency: Apply decision-making techniques**Competency Builders:**

- Identify decision to be made
- Identify ownership of decision to be made
- Identify possible alternatives and their consequences
- Make decisions based on facts, legality, ethics, goals, and/or culture
- Apply time factor(s)
- Present decision to be implemented
- Evaluate decision made
- Take responsibility for decision

Competency: Apply problem-solving techniques

Competency Builders:

Identify problem

Select appropriate problem solving tools/techniques

Identify root problem cause(s)

Track root problem cause(s)

Identify possible solutions and their consequences (e.g., long term, short term, crisis)

Use resources to explore possible solutions to problem

Contrast advantages and disadvantages of each solution

Identify appropriate action

Evaluate results

Identify post-preventive action

Competency: Exhibit characteristics for job advancement

Competency Builders:

Display positive attitude

Demonstrate knowledge of position

Perform quality work

Adapt to changing situations and technology

Demonstrate capability/responsibility for different positions

Identify characteristics of effective leaders

Identify opportunities for leadership in work place/community

Demonstrate initiative to affect change in workplace

Participate in continuing education/training program

Responds appropriately to criticism from employer, supervisor, or other employees

Exhibit awareness of corporate culture

Prepare for job setbacks

Exhibit continual growth based on performance evaluation

Set realistic goals

Unit: Professionalism

Competency: Project professional image

Competency Builders:

- Define professionalism
- Exhibit professional appearance
- Exhibit professional manners
- Project professional attitude
- Identify individuals' vital role in organization
- Exhibit proper etiquette in professionally-related situations

Competency: Achieve individual and professional goals

Competency Builders:

- Set flexible, realistic, and measurable goals
- Identify potential barriers to achieving goals
- Identify strategies for addressing barriers to goal achievement
- Breakdown long-term goals into short-term goals
- Prioritize goals
- Commit to goals
- Adjust goals
- Obtain support for goals
- Reward goal achievement

Competency: Manage personal finances

Competency Builders:

- Explain need for personal management records
- Balance checkbook
- Identify tax obligations
- Analyze how credit affects financial security
- Compare types and methods of investments
- Compare types and methods of borrowing
- Compare types and methods of insurance
- Compare types of retirement options/plans
- Identify discriminatory vs. non-discriminatory expenditures

Competency: Support community well-being

Competency Builders:

Identify environmental, educational, and social issues
Participate in social and/or community activities

Competency: Achieve organizational goals

Competency Builders:

Evaluate personal goals in relation to organizational goals
Monitor progress by evaluating feedback
List responsibilities in relation to organization goals
Accomplish assigned tasks
Exercise responsibility in relation to organizational goals
Set appropriate personal performance standards
Communicate goals with supervisor and peers
Demonstrate knowledge of products and services
Promote organizational image and mission

Competency: Demonstrate positive relations in the workplace

Competency Builders:

Identify personality types of self and other
Identify various management styles
Support employer expectations
Support employer decisions
Accept constructive criticism
Give constructive feedback
Adapt to changes in workplace
List factors to consider before resigning
Write letter of resignation

Competency: Manage stressful situations**Competency Builders:**

Accept stress as part of daily life
 Identify personal and professional factors contributing to stress
 Describe physical and emotional responses to stress
 Evaluate positive and negative effects of stress on productivity
 Identify strategies for reducing stress
 Implement strategies to manage stress
 Create strategies for developing and maintaining support systems

Competency: Analyze effects of family on work and work on family**Competency Builders:**

Identify how family values, goals, and priorities are reflected in work place
 Identify responsibilities and rewards associated with paid and non-paid work
 Identify responsibilities and rewards associated with families
 Explain how family responsibilities can conflict with work
 Explain how work can conflict with family responsibilities
 Explain how work-related stress can affect families
 Explain how family-related stress can affect work
 Identify family support systems and resources
 Identify work-related support systems and resources
 Communicate with family regarding work

Competency: Apply lifelong learning skills**Competency Builders:**

Define lifelong learning
 Identify factors that cause need for lifelong learning
 Analyze effects of change
 Identify reasons why goals change
 Describe importance of flexibility and adaptability
 Evaluate need for continuing education/training

Competency: Manage professional development

Competency Builders:

Identify career opportunities
Modify career plan
Participate in continuing education/training opportunities
Document continuing education/training
Read profession-related manuals, technical journals, and periodicals
Attend meetings, workshops, seminars, conferences, and demonstrations
Participate in professional organizations
Build personal/professional mentor relationship
Build personal/professional support system
Build professional network
Strengthen communication skills
Strengthen leadership skills
Strengthen management skills

Unit: Teamwork

Competency: Demonstrate knowledge of teamwork

Competency Builders:

- Define empowerment
- Differentiate work groups and teams
- Identify conditions essential to teamwork (e.g., brainstorming)
- Explain influence of culture (e.g., corporate, community) on teamwork
- Identify appropriate situations for using teams
- Define team structures (e.g., cross functional, quality improvement, task force, quality circles)
- Identify team building concepts
- Describe characteristics and dynamics of teams
- Identify characteristics of effective team leaders and members
- Identify responsibilities of a valuable team member
- Identify methods of involving each member of a team
- Explain how individuals from various backgrounds contribute to work-related situations (e.g., technical training, cultural heritage)
- Explain the purpose of facilitators
- Define consensus
- Define reward/recognition system

Competency: Demonstrate teamwork

Competency Builders:

- Identify purpose of team and intended goal (include time frames)
- Structure team around purpose
- Define responsibilities of team members
- Contribute to efficiency and success of team
- Work toward individual and team milestones
- Analyze results of team project
- Facilitate a team meeting
- Assist team member(s) with problem
- Monitor time frame
- Stress continuous improvement
- Accept failure as part of learning

Competency: Use teamwork to solve problems

Competency Builders:

Identify appropriate situations for using teams
Use problem-solving process in a team setting
Identify quality management processes/techniques
Identify quality assurance processes/techniques
Prepare presentation

Competency: Conduct team meetings

Competency Builders:

Plan agenda
Schedule meeting and location
Invite appropriate personnel
Solicit outside speakers as needed
Assign someone to take minutes
Facilitate introductions
Invite questions and comments and group participation
Focus team on agenda items
Assign appropriate action, time frame and accountability to tasks
Monitor time
Close meeting on time
Publish minutes in timely manner
Set ground rules
Avoid placing individual agendas above the group's agenda

Unit: Quality Assurance**Competency: Demonstrate knowledge of quality assurance****Competency Builders:**

- Explain the historical evolution of quality assurance (e.g., Deming, ISO 9000)
- Explain changes brought about by quality leaders in the world
- Explain the ISO 9000 process
- Define quality terms
- Define quality functions
- Identify features of quality planning
- Describe control devices used in functional areas (e.g., SPC, equipment)
- Explain the relationship among organizational structures, policies, procedures, and quality assurance
- Explain importance of internal and external customers
- Identify internal and external customers
- Describe successful efforts by industry to improve quality and/or reduce costs
- Differentiate prevention and detection
- Differentiate variable and attribute data
- Identify types of control charts
- Explain how statistical techniques are tools used to control quality (e.g., SPC, DOE, CR)

Competency: Demonstrate knowledge of quality cost implications

Competency Builders:

Identify cost/quality objectives

Classify costs (i.e., direct and indirect, fixed and variable, methods and standards)

Classify quality costs (i.e., prevention, evaluation, pre-delivery failure, post-delivery failure)

Define produce liability

Interpret quality cost reports

Explain consumerism and liability prevention

Define safety terms of product

Identify safety responsibility within organization

Define contracts and torts

Differentiate express and implied warranty

Differentiate warranty and product liability

Explain how warranties are part of contract law

List questions that would need answering in liability claim

Competency: Demonstrate knowledge of engineering a quality product

Competency Builders:

Associate customer satisfaction with product characteristics (e.g., usefulness, price, operation, life, reliability, safety, cost of operation)

Define manufacturability

Identify steps in product design (e.g., brainstorming, thumbnail sketches, rendering)

Define reliability factors (e.g., cost, human, producibility)

Identify ways reliability is achieved (e.g., maintainability, good design, design simplification, design redundancy)

Explain the relationship of maintainability to reliability

Define failure

Explain the role of testing and reliability

Define value engineering

Define quality objectives

Identify cost components as they relate to quality objectives

Classify quality costs (i.e. preventive, evaluation, pre-delivery failures, post delivery failures)

Describe predictive maintenance

Competency: Explain importance of interdepartmental relationships to quality assurance

Competency Builders:

Explain need for everyone's commitment in assuring quality
Explain phrase "Everyone is a customer/supplier"
Define quality improvement team models
Explain the importance of top management's support of quality
Explain project selection
Explain project implementation
Explain project evaluation
Explain continuing improvement
Describe future trend of experiment design
Describe future trend of predictive maintenance

Competency: Manipulate quality cost data

Competency Builders:

Develop quality cost data
Translate cost reports
Graph quality cost data (e.g., pareto)

Competency: Manipulate cost control data

Competency Builders:

Develop cost control data
Analyze cost control reports
Provide cost control data
Provide advice on "Make or Buy" decisions (including economical lot size decisions)

Competency: Demonstrate knowledge of basic statistics

Competency Builders:

Describe data collection methods

Collect data

Organize data by flow chart

Interpret data by cause and effect diagrams

Define nominal, ordinal, interval, and ratio data

Define mean, median, and mode

Explain significance of standard deviation

Explain normal distribution

Competency: Demonstrate knowledge of scattergrams

Competency Builders:

Construct scattergram

Interpret for positive, negative, or no correlation between X and Y variables

Test for significance between one and five percent

Explain regression analysis

Competency: Demonstrate knowledge of probability theory

Competency Builders:

Define classical probability

Define empirical probability

Calculate probability for outcomes

Competency: Demonstrate knowledge of precontrol**Competency Builders:**

Explain uses of precontrol
Calculate precontrol limits
Explain significance of the limits
Plot values on a precontrol chart
Explain "out-of-control" situation
Make decisions on green, yellow and red conditions

Competency: Demonstrate knowledge of process capability**Competency Builders:**

Use $\bar{X}$, R , USL , and LSL to determine process capability (upper and lower specification limits)
Calculate estimated process standard deviation
Plot right hand and left hand tail of process variation
Compute Z value for percent of probable defect for process
Calculate C_{PK} values that describe process capability
Describe skewed distributions
List probable causes of skewed distribution

Competency: Use quality control charts

Competency Builders:

- Identify operational definitions for attribute criteria
- Interpret histogram
- Interpret scattergrams
- Interpret NP chart
- Interpret P chart
- Interpret flowchart
- Interpret cause-and-effect diagram
- Construct P (percentage defective) chart for attributes
- Plot control limits of P chart and data points
- Check chart for out-of-control conditions
- Construct an NP (number defective) chart with control limits and data
- Construct C (count of defects) and U (number of defects per unit) charts
- Check data on C and U charts
- Construct flowchart
- Construct cause-and-effect chart

Competency: Interpret $\bar{X}$ and R charts

Competency Builders:

- Plot percentages for normal distribution
- Test distribution for normality
- Explain difference between common cause and special cause
- Define an "in-control" process
- Explain significance of an out-of-control point on $\bar{X}$ or R chart
- Identify patterns and trends on control chart
- Identify run up and run down
- Test for middle third on control chart
- Explain significance of middle third on control chart
- Explain Rule of Sevens

Competency: Construct $\bar{X}$ and R charts**Competency Builders:**

Arrange data into statistical sub-groups

Explain importance of random sampling

Compute $\bar{X}$ (i.e., average of values) and R (i.e., range of values in subgroup) within sample

Plot in $\bar{X}$ and R on chart

Construct control chart with $\bar{\bar{X}}$ (grand average) and R (average range) calculated

Calculate upper and lower control limits for $\bar{X}$ -chart

Calculate upper and lower control limits for R-chart

Competency: Conduct process improvement studies**Competency Builders:**

Analyze production methods and processes applying statistical process improvement techniques (e.g., SPC, C_{PK})

Identify appropriate statistical techniques for study (e.g., T-tests, F-test, capability, DOEX)

Identify major steps in conducting a study

Define "report" for a study (e.g., goal, objective, study conduct, results, conclusions, discussions)

Integrate results into the total system

Competency: Demonstrate knowledge of JIT**Competency Builders:**

Define just-in-time concept (JIT)

Describe various production methodologies (e.g., standard cycle times, routings, standard quantities, multiple-machine tending)

Describe types of inventory control (e.g., Kanban)

Describe importance of flexibility

Differentiate product layout, process layout, fixed position layout, and cellular layout

Differentiate straight-line, U-shaped, S-shaped, convoluted and comb patterns

Describe advantages/disadvantages of layout and patterns

Explain importance of product protection, identification and storage

List methods of identifying products (e.g., labels, bar codes, radio frequency systems and magnetic strip systems)

Describe manual methods of storage and retrieval

Describe automated storage and retrieval systems (ASRS)

Describe automated guided vehicle moving systems (AGVS)

Competency: Apply JIT**Competency Builders:**

Maintain system for physical handling and movement of material in-process and in-storage

Monitor system of physical handling and movement of material in-process and in-storage

Maintain system for physical handling and movement of finished products

Monitor system of physical handling and movement of finished products

Write requests for deviation from specifications

Implement quality control and inspection standards and procedures

Write engineering change notices and rejection reports

Monitor reports of discrepancy or rejects during production process

Conduct quality tests under different environmental conditions

Competency: Demonstrate knowledge of inspection

Competency Builders:

Explain purpose of inspection
 Describe scope of inspection
 Explain purpose of incoming, ongoing, and final inspections
 Explain early detection inspection
 Explain how statistical process control (SPC) aids inspection
 Define types of nonconformance
 Define degrees of nonconformance
 Define corrective action
 Describe when to 100% inspect
 Describe when to sample inspect
 Describe methods of testing for material properties (e.g., harness, strength, chemical makeup, flaws, errors in tooling or setup)
 Define rework, salvage, and scrap
 Describe ethical decisions an inspector may make
 Identify purposes of computer-automated inspection
 Explain advantages and limitations of automated inspection
 Explain disposition of non-conforming material
 Explain basic foolproofing concept to build inspection into process (i.e., poka-yoke)
 Use checksheets to organize and record inspection results

Competency: Inspect machinery, materials, and products

Competency Builders:

Identify critical material characteristics from specification(s) or drawing(s)
 Perform capability studies for machinery and materials acceptance
 Identify appropriate acceptance sampling plan
 Conduct incoming materials inspection using sampling plan criteria
 Identify critical in-process characteristics from specification(s) or drawing(s)
 Demonstrate basic metrology skills
 Conduct in-process inspection
 Identify appropriate inspection reports and follow-up
 Gauge R and R (reproducibility and repeatability)
 Apply geometric tolerancing
 Explain C = O (zero) acceptance plan
 Interpret instructions in a control plan

Competency: Demonstrate knowledge of nondestructive testing

Competency Builders:

Describe purpose of nondestructive testing

Identify anomalies

Define defects and discontinuities

Identify factors contributing to defects and discontinuities

Describe ultrasonic testing

Describe advantages and limitations of ultrasonic testing

Describe industrial radiography

Compare use of wet and dry particles in magnetic particle inspection

Explain advantages and limitations of penetrant inspection

Describe microwave testing

Describe holographic inspection

Explain choice of most suitable nondestructive test method

Describe eddy-current testing

Unit: Technical Recording and Reporting

Competency: Demonstrate proficiency in technical recording

Competency Builders:

Describe various documentation procedures
Interpret specifications or drawings
Observe process
Ask open-ended questions
Record process (e.g., flowchart, step-by-step)
Identify parameters
Record accurate, truthful data
Maintain test logs
Compile cumulative reference notebook/record
Measure appropriate parameters
Draft preventive maintenance and calibration procedures

Competency: Demonstrate proficiency in technical reporting

Competency Builders:

Use data books and cross reference/technical manuals
Compose technical memoranda
Identify type of report or format needed
Use appropriate format
Compile relevant data
Design charts and graphs
Analyze data
Draw conclusions
Explain analytical methods used
Outline reports
Write reports
Present reports

Unit: Computer Literacy**Competency: Describe personal computer operations****Competency Builders:**

Explain how data is stored in main computer memory
Explain how computer system executes program instruction
Explain computer storage capacity
Explain how data is represented
Describe data storage techniques
Identify types of memory

Competency: Explain information processing cycle**Competency Builders:**

Define operating systems (e.g., DOS, OS/2, UNIX, MAC)
Describe computer languages and their use
Describe computer languages and their use
Describe computer languages and their use
Describe difference between data files and program files
Explain PC layout
Explain PC network layout
Explain mini/mainframe network layout
Differentiate hardware and software
Differentiate open from proprietary architecture

Competency: Operate computer hardware**Competency Builders:**

Practice proper media handling techniques (e.g., magnetic fields, dust, liquids)
Identify hardware and its use
Use hardware (e.g., mouse, diskettes, drive, modems, touch screen, printers, digitizers, scanners, cables, protection devices)
Keyboard efficiently
Demonstrate basic care of hardware
Explain need for and application of security levels/procedures
Perform basic hardware troubleshooting
Explain hardware addressing techniques

Competency: Use software**Competency Builders:**

Define software types and functions
Describe basic disk operations and care
Perform functions necessary to operate software
List advantages and disadvantages of integrated and dedicated software
Operate system software
Operate diagnostic software
Demonstrate basic proficiency in spreadsheet use
Demonstrate basic proficiency in word processing
Demonstrate basic proficiency in database use
Demonstrate basic proficiency in network use
Demonstrate basic proficiency of utility (e.g., WINDOWS, GUI)
Demonstrate basic proficiency in report writing
Demonstrate system commands
Differentiate ethical use/misuse of software
Describe bulletin boards/electronic mail
Apply security levels/procedures while handling sensitive data
Explain data compression techniques
Explain use and deletion of passwords

Competency: Demonstrate knowledge of safety and workplace hazards

Competency Builders:

Describe corrective procedures for unsafe conditions
 Identify types and potential level of workplace hazards (e.g., physical hazards, fire, chemicals, noise, ionizing radiation, ultraviolet, temperature extremes, ergonomics, biological hazards)
 Identify safety materials/equipment (e.g., absorbant socks, oil dry)
 Interpret Material Safety Data Sheets (MSDS)
 Explain purpose(s) of OSHA and NIOSH
 Explain purpose(s) of NEC and NFPA
 Identify purpose of emergency evacuation routes, master switch and lockout locations, and safety color coding systems
 Identify roles of industrial hygienists, safety professionals, occupational physicians, and occupational nurses
 Describe methods of evaluating potential hazards (e.g., visual analysis)
 Describe methods of correcting potential hazards
 Describe various types of toxicity (e.g., chronic, immediate)
 Identify need for reporting accidents
 Explain precautions required when using toxic or flammable materials
 Define confined space and related requirements
 Explain how international directives relate to safety

Competency: Explain purpose of industrial pollution control systems

Competency Builders:

Describe types of air, water, solid waste, and noise pollution
 Explain purpose of air pollution control systems
 Explain purpose of water pollution control systems
 Explain purpose of solid waste pollution control systems
 Explain purpose of noise pollution control systems
 Explain basic philosophy of "right to know" legislation
 Explain purpose(s) of EPA
 Identify "costs" of industrial pollution control (i.e., dollars vs. impact to environment)
 Describe ethics of environmental issues

Competency: Demonstrate knowledge of ergonomics

Competency Builders:

Define ergonomics

Define risk factor

Define maximum permissible limit (MPL) and action limit (AL) for lifting

Define cumulative trauma disorder (CTD)

Identify susceptibility factors for CTD

Minimize extreme joint movement

Minimize use of excessive muscle force

Minimize repetitive tasks

Minimize mechanical stresses (e.g., sharp edges, heat, cold, hard surfaces, weights, vibration)

Minimize awkward body positions

Explain use of rest pauses

Explain need for mats and footrest for standing jobs

Explain need for appropriate working heights of chairs, stools, workbenches, equipment

Explain need for adequate lighting

Explain use of anthropometric (i.e., centering one's view of everything around man) design

Unit: Basic Electronics

Competency: Demonstrate proficiency in electronics fundamentals

Competency Builders:

Identify electronic components and schematic symbols
Describe basic atomic structure and its relationship to electricity
Describe the relationship between electrical and magnetic properties
Describe the electrical and magnetic properties of a magnet
Describe the photoelectric effect
Describe the thermocouple effect
Describe the electrical effect of friction
Use metric units to solve electronic unit problems
Identify sources of electricity
Describe principles and operations of electrochemical supplies
Describe voltage, current, resistance, power, and energy
Apply Ohm's Law
Apply Kirchhoff's Laws
Apply power formulas
Explain Thevenin's Theorem
Explain Norton's Theorem
Interpret color codes and symbols to identify electrical components and values
Measure properties of circuits using test equipment
Describe electrostatic discharge (ESD) procedures

Competency: Demonstrate proficiency in AC circuits**Competency Builders:**

Analyze properties of an AC signal

Describe principles and operation of characteristics of sinusoidal and non-sinusoidal wave forms

Identify AC sources

Describe principles and operation of characteristics of capacitive circuits

Operate capacitive circuits

Describe principles and operation of characteristics of inductive circuits

Operate inductive circuits

Describe principles and operation of transformers

Demonstrate operation of AC circuits utilizing transformers

Use maximum power transfer theorems

Use Thevenin's and Norton's theorem to analyze AC circuits

Measure power in AC circuits

Operate capacitor and inductor analyzers for AC circuits

Operate differentiators and integrators to determine RC and RL time constants

Describe principles and operation of characteristics of series and parallel resonant circuits

Build series and parallel resonant circuits

Identify classes, voltage, ratings and/or polarity of electronic components

Identify use of circuit protective devices (e.g., fuses, breakers)

Describe principles and operation of characteristics of frequency selective filter circuits

Calculate logarithmic to obtain gain (dB) using tables or calculator/computer

Operate frequency selective filter circuits

Operate polyphase circuits

Describe basic motor theory and operation

Describe basic generator theory and operation

Operate power supplies for AC circuits

Describe principles and operation of various power conditioning (e.g., isolation transformers, surge suppressors, uninterruptable power systems)

Describe principles and operation of various safety grounding systems (e.g., lightning arresters, ground electrostatic discharge, fault interrupters, etc.)

Describe characteristics of inductors in series and parallel circuits

Describe characteristics of capacitance in series and parallel circuits

Compare resistive-capacitive (RC) and resistive-inductive (RL) time constants (TC)

Measure voltage, current, time, frequency (f), and phase relationships of AC sine wave signal

Describe frequency (F) and phase relationships

**Competency: Demonstrate proficiency in AC circuits
(CONTINUED)**

Competency Builders:

Describe resonance of inductive-capacitive (LC) circuits
Calculate impedance match and maximum transfer of power
Measure current, voltage, and resistance in AC circuits
Identify 50/60 Hertz
Explain simple AC generator action
Explain simple AC motor action
Calculate power factor in AC circuits
Explain harmonics and its effects on power quality
Solve basic trigonometric problems as applicable to electronics
Calculate peak (PK), root mean square (RMS), and average values
Troubleshoot AC circuits

Unit: Fundamentals of Electronics Technology

Competency: Demonstrate proficiency in discrete solid-state devices

Competency Builders:

Describe properties of semiconductor materials
Describe operating characteristics and applications of PN junctions
Demonstrate operation of diode circuits
Troubleshoot diode circuits
Repair diode circuits
Describe operating characteristics and applications of bipolar transistors
Describe operating characteristics and applications of field effect transistors
 (e.g., FET + s/MOSFET + s)
Describe operating characteristics and application of special diodes/transistors
Describe operating characteristics and applications of opto-electronic devices
 (e.g., gate isolators, interrupt sensors, infrared sensors)
Describe operating characteristics and applications of single-stage amplifiers
Demonstrate the operation of the single-stage amplifiers
Troubleshoot single-stage amplifiers
Repair single-stage amplifiers
Demonstrate the operation of thyristor circuitry (SCR, TRIAC, DIAC, etc.)
Troubleshoot thyristor circuitry (SCR, TRIAC, DIAC, etc.)
Operate analog and digital equipment for solid-state devices
Operate power supplies for solid-state devices
Operate oscilloscopes for solid-state devices
Operate function generators for solid-state devices
Operate curve tracers
Operate transistor testers

Competency: Demonstrate proficiency in analog circuits

Competency Builders:

Operate measuring instruments for analog circuits

Describe operating characteristics and applications of linear integrated circuits

Describe operating characteristics and applications of power supplies and filters

Describe operating characteristics and applications of operational amplifier circuits

Demonstrate the operation of operational amplifier circuits

Describe the operating characteristics and applications of regulated and switching power supply circuits

Demonstrate the operation of regulated power supply circuits

Describe operating characteristics and applications of active filters

Demonstrate the operation of active filter circuits

Describe operating characteristics and applications of sinusoidal and non-sinusoidal oscillator circuits

Demonstrate the operation of oscillator circuits

Describe the operating characteristics and applications of motor phase-shift control circuits (single-phase and multi-phase)

Describe the operating characteristics and applications of cathode ray tubes

Competency: Demonstrate proficiency in digital circuits**Competency Builders:**

Operate logic problems for digital circuits
Operate power supplies for digital circuits
Operate pulsed for digital circuits
Operate oscilloscopes for digital circuits
Describe characteristics of integrated circuit (IC) logic families
Describe the principles and operation of types of logic gates and their truth tables
Demonstrate the use of logic gates
Describe the principles and operation of combinational logic circuits
Demonstrate the operation of combinational logic circuits
Describe the principles and operation of numbering systems, codes, and arithmetic operations
Minimize logic circuits using Boolean operations
Describe the principles and operation of types of flip-flops
Demonstrate the operation of flip-flops
Describe the principles and operation of types of registers and counters
Demonstrate the operation of registers and counters
Describe the principles and operation of clock and timing circuits
Demonstrate the operation of clock and timing circuits
Describe the principles and operation of types of arithmetic-logic circuits
Demonstrate the operation of arithmetic-logic circuits
Describe the principles and operation of types of encoders and decoders
Demonstrate the operation of encoders and decoders
Describe the principles and operation of types of multiplexer and demultiplexer circuits
Demonstrate the operation of multiplexer and demultiplexer circuits
Describe the principles and operation of digital-to-analog and analog-to-digital circuits
Demonstrate the operation of digital-to-analog and analog-to-digital circuits
Describe the principles and operation of types of digital display circuits
Demonstrate the operation of digital display circuits
Describe the types of digital display devices
Demonstrate the operation of digital display devices
Describe the operating characteristics and applications of fiber optics
Demonstrate the operation of fiber optics

Competency: Demonstrate basic proficiency in microprocessors

Competency Builders:

- Describe the essential components of a microprocessor and their functions
- Identify the levels of computer languages
- Operate oscilloscopes and logic/data analyzers
- Describe the principles and operation of BUS concepts
- Describe the principles and operation of types of memory circuits
- Demonstrate the operation of memory circuits
- Troubleshoot memory circuits
- Repair memory circuits
- Describe microprocessor instruction sets
- Describe the principles and operation of microprocessor machine code
- Demonstrate the use of microprocessor machine code
- Debug microprocessor machine code
- Interface various types of peripherals
- Describe the use of microprocessor simulator(s)

Competency: Describe manufacturing of electronic devices and micromechanisms

Competency Builders:

- List properties of electronic packaging materials
- Describe manufacturing of electronic products chips; integrated circuits; printed integrated circuits
- Describe joining and assembly of electronic components
- Describe coating and etching processes
- List principles of packaging electronic components
- Describe manufacture of miniature devices
- Describe testing of joints
- Describe reliability of electronic product testing
- Describe the advantages and disadvantages of various advanced packaging techniques (e.g., SMD, MCM)
- Describe methods of fabrication

Unit: Troubleshooting and Repair**Competency: Demonstrate troubleshooting skills****Competency Builders:**

Explain role of preventive maintenance
Differentiate normal and abnormal operations
Explain troubleshooting procedures
Explain logical actions taken to troubleshoot
Use proper troubleshooting aids
Demonstrate knowledge of safety rules for troubleshooting and repair procedures
Maintain troubleshooting and repair records
Interpret prints (e.g., PID, loopsheets)
Use manufacturer's manuals, schematics, and troubleshooting charts
Isolate faults, shorts, and open circuits

Competency: Apply troubleshooting techniques to DC circuits**Competency Builders:**

Identify noise problems
Isolate faults in series, parallel and series parallel
Isolate faults in bridge circuits
Isolate faults in DC power supplies
Perform polarity check
Isolate faults to DC drive system
Isolate faults in voltage divider circuits
Repair faults

Competency: Apply troubleshooting techniques to AC circuits

Competency Builders:

- Isolate faults in capacitive circuits
- Isolate faults in inductive circuits
- Isolate faults in AC circuits utilizing transformers (e.g., step up and step down)
- Isolate faults in differentiator and integrator circuits
- Isolate faults in RC, RL, and RLC circuits
- Isolate faults in frequency selective filter circuits
- Isolate faults to AC frequency drive systems
- Repair faults

Competency: Apply troubleshooting techniques in discrete solid-state devices

Competency Builders:

- Isolate faults in diode circuits
- Isolate faults in thyristor circuitry (e.g., SCR, TRIAC, DIAC)
- Isolate faults in transistor circuits
- Isolate faults in operational amplifier circuits
- Isolate faults in single-stage amplifiers
- Isolate faults in open circuits
- Repair faults

Competency: Apply troubleshooting techniques to analog circuits

Competency Builders:

- Isolate faults in single and multistage amplifiers
- Isolate faults in audio power amplifiers
- Isolate faults in regulated and switching power supply circuits
- Isolate faults in active filter circuits
- Isolate faults in oscillator circuits
- Isolate faults in operational amplifier circuits
- Isolate faults in power supplies (loaded and unloaded) and filters
- Repair faults

Competency: Apply troubleshooting techniques to digital circuits

Competency Builders:

Identify noise problems
Isolate faults in multiplexer and demultiplexer circuits
Isolate faults in digital display circuits
Isolate faults in logic gates
Isolate faults in flip-flops
Isolate faults in registers and counters
Isolate faults in clock and timing circuits
Isolate faults in arithmetic-log circuits
Isolate faults in encoders and decoders
Isolate faults in digital-display devices
Repair faults

Competency: Apply troubleshooting techniques to a microcomputer system

Competency Builders:

Isolate faults to systems boards
Isolate faults to memory circuits
Isolate faults to data storage devices
Isolate faults in power supplies
Troubleshoot I/O ports
Isolate faults in I/O interface circuitry
Use diagnostic software
Repair faults

Competency: Apply troubleshooting techniques to manufacturing systems

Competency Builders:

- Identify individual process blocks of assembly line or process
- Identify process block interfaces
- Demonstrate steps required for efficient systems troubleshooting
- Isolate system faults to process block
- Isolate block faults using schematics
- Isolate block faults using programmable controller indicators
- Isolate block faults using volt meter
- Repair block faults by replacing fault component or wiring

Unit: Microcomputer Electronics Technology

Competency: Demonstrate basic proficiency in microprocessor systems

Competency Builders:

Describe essential components of microprocessor and their functions
Describe principles and operation of BUS concepts (e.g., VESA, EISA)
Describe principles and operation of types of memory circuits
Identify operating systems (e.g., DOS, OS/2, UNIX)
Describe microprocessor instructions sets
Describe principles and operation of microprocessor machine code
Demonstrate use of microprocessor machine code
Decode microprocessor machine code
Identify types of input and output devices and peripherals
Describe principles and operation of storage devices
Operate oscilloscopes and logic/data analyzers
Interface input and output ports to peripherals
Demonstrate ability to interface peripherals
Identify central processing unit building blocks and their uses
Identify the levels of computer languages

Competency: Demonstrate basic proficiency in computer systems architecture

Competency Builders:

- Describe the principles and operation of computer system architecture
- Operate computer system architecture
- Repair computer system architecture
- Describe the principles and operation of addresses and interrupts
- Describe the principles and operation of volatile and non-volatile memory
- Demonstrate the use of volatile and non-volatile memory
- Repair or replace volatile and non-volatile memory
- Describe the principles and operation of advanced memory techniques
- Define individual system blocks
- Draw systems configuration in block detail
- Interpret computer acronyms
- Describe priorities and interrupts at systems level
- Identify direct memory access data handling system(s)
- Define functions of advanced memory techniques (e.g., virtual, pipeline, cache)
- Troubleshoot a microcomputer system

Competency: Demonstrate proficiency in software fundamentals

Competency Builders:

- Load operating system software
- Run operating system software
- Load diagnostic software
- Run diagnostic software
- Construct flow charts
- Analyze flow charts
- Explain computer languages and their uses
- Write a simple computer program
- Write program documentation
- Describe firmware applications
- Identify the need for backup
- Describe security measures
- Describe virus protection

Competency: Describe elements of communication interfacing

Competency Builders:

Define common EIA, IEEE, and CCITT communication standards (e.g., EIA 232 and 485; IEEE 488)

Identify sync devices

Identify async devices

Identify types of network (e.g., token ring, ethernet)

Identify networking levels or layers

Identify protocols

Identify packet switching

Identify multiuser systems

Operate network analyze devices

Identify network analyzer devices (e.g., breakout bos, sniffers)

Competency: Describe peripheral equipment interfaces

Competency Builders:

Identify types of card and paper-tape equipment and interface controllers

Define printer types and interface controllers

Explain the operation of typical magnetic tape equipment and interface controllers

Identify disk equipment and interface controllers

Define environmental requirements for peripherals and media

Unit: Instrumentation Control Technology**Competency: Describe instrument loops****Competency Builders:**

Use Instrumentation Society of America (ISA) symbology
Describe types of transmitters (e.g., flow, level, pressure, temperature)
Describe elements of a control loop (e.g., transmitter, indicator, controller, transducer, control valve)
Describe signals
Describe modes of control operation (e.g., manual, automatic, cascade, program)
Describe details of flow loop [e.g., orifice plate, segmental wedge, differential pressure transmitters (electronic and pneumatic), magnetic, turbine type transmitters, local indicators, controller, transducer, control valve]
Describe types of transmitters used in level control loops
Describe details of pressure transmitters
Describe details of temperature elements (thermocouples and RTD's) and transmitters
Describe details of infrared and photosensors
Describe details of proximity/vibration sensors
Describe details of speed/acceleration sensors
Describe details of resolver encoder
Describe details of linear voltage detection transformers (LVDT)

Competency: Calibrate loop elements**Competency Builders:**

Identify manufacturer's requirements
Identify loop requirements
Verify function of test equipment
Set up test procedure
Perform calibration
Record results

Competency: Build control loops

Competency Builders:

Build flow loop
Build level control loop
Build pressure loop
Build temperature loop

Competency: Perform calculations

Competency Builders:

Calculate orifice plate sizing
Calculate flow transmitter differential pressure
Calculate control valve sizing

Competency: Describe distributed control systems

Competency Builders:

Describe various types of I/O
Describe various types of alarms
Describe system architecture

Competency: Describe types of controller action

Competency Builders:

Describe proportional control action
Describe proportional and integral control action
Describe proportional, integral, and derivative control action

Competency: Perform loop tuning

Competency Builders:

Troubleshoot loops

Demonstrate effect of using only a proportional parameter

Demonstrate effect of using only proportional and integral parameters

Demonstrate effect of various values for proportional, integral, and derivative tuning parameters

Demonstrate loop training using "open loop" step testing

Demonstrate loop tuning using Ziegler Nichols method

Unit: Communications Electronics Technology

Competency: Describe transmission line applications

Competency Builders:

Explain power conversion

Describe principles and operation of two wire and four wire transmission lines

Describe principles and operation of coaxial cable

Describe principles and operation of microwave guide

Describe principles and operation of fiber optics

Competency: Demonstrate proficiency in transmitters and receivers

Competency Builders:

Explain the purpose of Federal Communication Commission (FCC) rules and regulations

Describe principles and operation of RF amplifiers

Describe principles and operation of modulation/demodulation (e.g., AM, FM, SSB, Fiber optic, DSSC)

Construct modulation/demodulation

Operate modulation/demodulation

Describe principles and operation of microwave and satellite communication systems

Describe principles and operation of repeater systems (e.g., trunk and fiber/scramble/data)

Competency: Describe various types of multiplexing systems

Competency Builders:

Describe principles and operation of analog multiplexing systems (e.g., CATV)

Describe principles and operation of digital multiplexing systems (e.g., T-1, fiber)

Describe principles and operation of CRT modulation

Competency: Troubleshoot transmitters and receivers

Competency Builders:

Isolate system faults in RF amplifiers
 Isolate system faults in CRT modulation/demodulation circuits
 Isolate system faults in RF transmitters and receivers
 Isolate system faults in television modulation circuits

Competency: Demonstrate basic proficiency in data communications

Competency Builders:

Describe principles and operation of data communications, signaling systems, codes, formats and protocols
 Describe principles and operation of parallel and serial ports
 Describe principles and operation of synchronous and asynchronous signals
 Describe principles and operation of data modems
 Operate data modems
 Describe principles and operation of fax machines
 Describe principles and operation of types of carrier systems
 Describe principles and operation of various types of networks (e.g., ethernet, token ring)
 Demonstrate operation of various types of networks
 Describe proper techniques for cable termination (e.g., UTP, COAX, FIBER)
 Demonstrate proper techniques for cable termination

Competency: Troubleshoot data communications

Competency Builders:

Isolate system faults in data modems
 Isolate system faults in various types of networks
 Isolate system faults in various types of cable
 Isolate system faults in various types of carrier systems

Competency: Demonstrate basic proficiency in fiber optic communications systems

Competency Builders:

Describe proper techniques for fiber splicing
Demonstrate proper techniques for fiber splicing
Demonstrate techniques for fiber termination
Describe basic characteristics of optics such as reflection, total reflection, and refraction
Describe characteristics and components of fiber optic cables
Describe band width and attenuation limitations for fiber optic systems
Describe technique of wavelength multiplexing in fiber optic cables
Describe characteristics of various types of light sources and light detectors used in fiber optic systems
Describe components of fiber optic transmission systems
Describe transformation of data signals into light pulses
Operate a simple fiber optic data transmission system
Describe proper techniques of fiber termination

Competency: Demonstrate proficiency in RF systems safety

Competency Builders:

Demonstrate safety procedures for working with RF systems antennae and support structures (e.g., towers)
Demonstrate safety procedures for working with RF systems high voltage/power supply
Demonstrate safety procedures for working with RF generators
Demonstrate safety procedures for working with RF systems in confined space

Competency: Demonstrate basic proficiency in antenna systems

Competency Builders:

Describe the principles and operation of single element antennae (e.g., 1/4 wave dipole, longwire, vertical)

Describe the principles and operation of multi-element antennae (e.g., point-to-point, broadcast)

Describe the principles and operation of impedance matching of antennae systems

Describe antennae systems measurement

Operate antennae

Unit: Industrial Electricity

Competency: Explain basic industrial electricity theory

Competency Builders:

Describe atomic structure and its relationship to electricity
Describe the relationship between electrical and magnetic properties
Describe the electrical and magnetic properties of a magnet
Describe the photoelectric effect
Describe the thermocouple effect
Describe the electrical effect of friction
Identify sources of electricity
Identify potential sources of electricity
Describe differences between AC/DC
Describe effects varying degrees of electricity have on the human body

Competency: Use the National Electrical Code (NEC)

Competency Builders:

Use NEC to identify correct materials
Use NEC to identify correct methods
Use NEC to identify correct applications
Use NEC to identify correct safety procedures

Competency: Explain operation of electrical distribution systems

Competency Builders:

Follow NFPA, local, state, and national codes
Describe functions of permits and licensing requirements
Explain generation of electricity
Explain transmission of electricity
Explain end user distribution

Competency: Maintain basic electrical systems

Competency Builders:

- Replace electrical cords
- Replace batteries
- Replace fuse(s)
- Replace switches and other sensors
- Replace plugs and sockets
- Replace control panel components (e.g., relays, motor starters)
- Replace AC motors (e.g., 3 phase, single phase)
- Replace DC motors

Competency: Interpret electrical/electronic drawings

Competency Builders:

- Interpret basic electric/electronic standards and symbols (e.g., NEC, IEC)
- Interpret schematic drawings
- Interpret cable drawings
- Interpret component drawings
- Interpret logic diagrams
- Interpret control panel drawings
- Interpret connection drawings
- Interpret interconnection drawings
- Interpret printed circuit board drawings
- Interpret harness drawings
- Interpret package drawings
- Interpret mechanical/electronic production blueprints and assembly drawings

Competency: Demonstrate proficiency in direct current (DC) circuits

Competency Builders:

Describe voltage, current, resistance, power, and energy

Solve algebraic problems to include exponential (prerequisite to DC)

Measure properties of a circuit using volt-ohm meter (VOM) and digital volt-ohm meter (DVM) meters and oscilloscopes

Apply Ohm's Law

Construct parallel circuits

Construct series circuits

Construct series parallel and bridge circuits

Define voltage divider circuits (loaded and unloaded)

Construct DC circuits that demonstrate the maximum power transfer theory

Solve problems in electrical units utilizing metric units

Describe the principles and operation of electrochemical supplies

Apply Kirchoff's law

Interpret color codes and symbols to identify electrical components and values

Measure properties of a circuit using analog and digital meters and oscilloscopes

Measure conductance and resistance of conductors and insulators

Describe magnetic properties of circuits and devices

Describe the physical and electrical characteristics of capacitors and inductors

Describe RC and RL time constants

Set up power supplies for DC circuits

Operate power supplies for DC circuits

Analyze frequency spectrums

Apply Thevenin's and Norton's theorems

Competency: Demonstrate proficiency in alternating current (AC) circuits

Competency Builders:

Solve basic trigonometric problems as applicable to electricity (prerequisite to AC)

Analyze AC signals utilizing VOM, DVM, oscilloscope, frequency counter and function generator

Analyze power in AC circuits

Measure power in AC circuits

Operate capacitor and inductor analyzers for AC circuits

Analyze properties of an AC signal

Describe the principles and operation of the characteristics of sinusoidal and non-sinusoidal wave forms

Identify AC sources

Describe the principles and operation of the characteristics of capacitive circuits

Demonstrate the operation of capacitive circuits

Describe the principles and operation of the characteristics of inductive circuits

Demonstrate the operation of inductive circuits

Describe the principles and operation of the principles of transformers

Demonstrate the operation of AC circuits utilizing transformers

Operate differentiators and integrators to determine RC and RL time constants

Describe the principles and operation of the characteristics of RLC circuits (series, parallel, and complex)

Demonstrate the operation of RLC circuits (series, parallel, and complex)

Describe the principles and operation of the characteristics of series and parallel resonant circuits

Operate series and parallel resonant circuits

Describe the principles and operation of the characteristics of frequency selective filter circuits

Demonstrate the operation of frequency selective filter circuits

Operate polyphase circuits

Describe basic motor theory and operation

Describe basic generator theory and operation

Operate power supplies for AC circuits

Describe the principles and operation of various power conditioning (e.g., isolation transformers, surge suppressors, uninterruptable power systems)

Describe the principles and operation of various safety grounding systems (e.g., lightning arresters, ground fault interrupters, etc.)

Apply maximum power transfer theorems

Apply Thevenin's and Norton's theorems to analyze AC networks

Unit: Electrical Test and Measurement Equipment

Competency: Demonstrate proficient use of electrical test equipment

Competency Builders:

- Describe function and operation of logic probe and logic analyzer
- Describe function and operation of power monitor
- Describe function and operation of signal generator
- Describe function and operation of spectrum analyzer
- Describe function and operation of AC/DC hi-pot
- Describe function and operation of time-domain reflectometer (TDR)
- Describe function and operation of megger
- Describe function and operation of curve tracer/analogger
- Apply test equipment to DC circuits
- Apply test equipment to AC circuits
- Apply test equipment to solid-state devices
- Apply test equipment to digital circuits
- Apply test equipment to analog circuits
- Apply test equipment to microprocessors

Competency: Demonstrate proficient use of electrical measurement equipment

Competency Builders:

- Describe function and operation of analog volt-ohm-meter (AVOM)
- Describe function and operation of digital volt-ohm-meter (DVOM)
- Describe function and operation of amp probe
- Describe function and operation of oscilloscopes
- Describe function and operation of operation of infrared heat sensor
- Apply measurement equipment to DC circuits
- Apply measurement equipment to AC circuits
- Apply measurement equipment to solid-state devices
- Apply measurement equipment to digital circuits
- Apply measurement equipment to analog circuits
- Apply measurement equipment to microprocessors

Unit: Drafting Technology

Competency: Apply basic drafting skills

Competency Builders:

Use drafting equipment, measuring scales, drawing media, drafting instruments
and consumable materials, blueprint machine

Identify line styles, weights (alphabet of lines)

Select proper drawing scale, introduction to different types

Prepare title blocks and other drafting formats

Apply freehand and other lettering techniques

Prepare multi-view drawings

Prepare multi-view sketches

Prepare orthographic views

Prepare change control block

Describe change control block/revision block

Measure angles

Draw horizontal, vertical, angular, parallel, and perpendicular lines

Transfer an angle

Construct tangent lines (to arcs) and tangent arcs (to arcs)

Bisect angles and arcs

Bisect lines

Divide lines

Construct three-point circle

Construct regular hexagon, pentagon, and octagon

Reproduce a drawing

Prepare single-view drawings

Prepare dimension drawings

Interpret notes and dimensions to determine part

Draw arcs, circles, and conics

Transfer measurements

Competency: Apply intermediate drafting skills**Competency Builders:**

Describe types of blueprints and their applications
Apply isometric, oblique and perspective sketching techniques
Prepare isometric, oblique and perspective sketches
Prepare sectional views
Prepare auxiliary views
Identify ANSI symbols
Prepare views of drilled and tapped holes, counterbores, countersinks
Apply systems drafting techniques
Identify a bill of materials
Dimension drawings using ANSI 14.5 standards
Describe purpose of auxiliary and sectional views

Competency: Apply advanced drafting skills**Competency Builders:**

Interpret reports and specifications
Prepare pictorial drawings
Prepare schematics
Draw conics
Interpret basic pneumatic/hydraulic standard and symbols
Interpret various drawings (e.g., welding, casting, stamping, forging, civil, maps, pattern shop)

Competency: Interpret basic prints**Competency Builders:**

Visualize object from drawing
Interpret orthographic projections
Interpret isometric views
Interpret sectional views
Interpret detail and assembly drawings
Interpret dimensions
Interpret tolerances

Competency: Interpret intermediate prints

Competency Builders:

Interpret screw thread specifications

Identify structural steel shapes

Interpret special symbols

Interpret electrical, pneumatic/hydraulic drawings

Interpret schematics

Competency: Interpret advanced prints

Competency Builders:

Interpret GD&T characteristic symbols

Interpret GD&T supplementary symbols

Competency: Demonstrate knowledge of basic geometric dimensioning and tolerancing

Competency Builders:

Identify geometric characteristics and symbols (i.e., flatness, straightness, roundness, cylindricity, profile of line, profile of surface, perpendicularity, angularity, parallelism, circular runout, total indicated runout, position, concentricity, and symmetry)

Define maximum material condition

Define least material condition

Define regardless of feature size condition

Describe feature control blocks

Describe datum surfaces and targets

Define flatness (pitch)

Define straightness (yaw)

Define roundness

Define cylindricity

Define profile of line

Define profile of surface

Define perpendicularity

Define angularity

Define parallelism

Define circular runout

Define total runout

Define true position concept to determine tolerance for location of holes in mating parts

Competency: Convert dimensions and tolerances

Competency Builders:

Convert dimensions and tolerances from English units to metric units

Convert dimensions and tolerances from metric units to English units

Competency: Apply revision control process

Competency Builders:

Apply drawing balloons

Apply documentation (including project filing, back-up material, tracking process)

Apply change control block

Apply revision levels

Competency: Demonstrate dimensioning techniques

Competency Builders:

Construct arrowheads using various styles/disciplines

Apply symbols for surface and texture control

Add labels/notes to drawing

Interpret decimal tolerance dimensions

Dimension arcs

Dimension angles

Dimension curves

Dimension rounded-end shapes

Dimension spherical objects

Dimension cylindrical objects

Dimension cones, pyramids, and prisms

Dimension features on circular center line

Dimension theoretical point of intersection

Dimension object using rectangular coordinate system

Dimension object using polar coordinate system

Dimension object using tabular coordinate system

Dimension object using ordinate dimensioning system

Competency: Apply geometric dimensioning and tolerancing**Competency Builders:**

Interpret decimal tolerance dimensions
Calculate clearance fit tolerances of mating parts
Dimension clearance fit tolerances of mating parts
Calculate interference fit tolerances of mating parts
Dimension interference fit tolerances of mating parts
Calculate tolerances to mating parts using standard fit tables
Assign tolerances to mating parts using standard fit tables
Apply positional and form tolerancing symbols
Apply symbols for true position
Apply symbols for maximum material control and regardless of feature size
Calculate effects of dimensional stack-up
Calculate transitional fit tolerances
Dimension transitional fit tolerances

Competency: Perform basic physical layouts**Competency Builders:**

Use inside diameter (ID), outside diameter (OD), and hermaphrodite calipers
Layout with combination square
Layout with scribe, divider and trammel
Use surface plate
Use surface gage
Use layout fluid
Use V-blocks
Use clamps
Use angle plate
Use parallels
Use punches
Use transfer method tools
Use layout hammer
Use machinist's square
Use universal bevel protractor
Use machinist's scale

Competency: Prepare mechanical drawings

Competency Builders:

Interpret basic mechanical standards and symbols
 Prepare assembly drawings
 Prepare welding drawings
 Prepare bearing drawings
 Prepare casting drawings
 Prepare forging drawings
 Prepare tool drawings
 Prepare molding diagrams
 Prepare drawings with special processed holes
 Prepare stamping drawings
 Prepare numerical control drawings/instructions
 Prepare installation drawings
 Prepare purchase part drawings
 Prepare approval drawings

Competency: Prepare advanced mechanical drawings

Competency Builders:

Resolve problems by descriptive geometry and revolutions
 Use precision dimensioning to include geometric characters
 Use precision measuring instruments (e.g., calipers)
 Prepare fastener drawings
 Prepare cam drawings
 Prepare gear drawings
 Prepare spring drawings
 Prepare pulley and chain drive drawings

Unit: CADD Fundamentals

Competency: Demonstrate basic use of computer operating system

Competency Builders:

- Create ASCII text files with a text editor
- Explain rules for naming files and directories
- Manage files
- Create directories
- Remove directories
- Change directories
- Copy files
- Rename files
- Erase files
- Format diskettes
- Label diskettes
- Explain the syntax of operating system commands
- Use wildcards in operating system commands

Competency: Operate a CADD system

Competency Builders:

- Execute CADD system
- Use keyboard input
- Use screen and tablet menus
- Use other input devices (e.g., scanner, digitizer)
- Create scaled plots
- Operate a pen plotter
- Operate a printer-plotter (i.e., laser plotter)
- Access on-line help for commands
- Use file conversion
- Use data transfer

Competency: Select entities for action

Competency Builders:

- Add or remove entities separately
- Add or remove entities using a window
- Add or remove entities with a crossing-box
- Select entities using a fence
- Select entities by other methods (e.g., last, previous, type, all, etc.)

Competency: Create 2-D orthographic drawings

Competency Builders:

- Create primitive drawing entities
- Draw utilizing absolute Cartesian coordinates
- Draw utilizing relative Cartesian coordinates
- Draw utilizing polar coordinates
- Draw using construction aides (e.g., snaps, grid, snap, etc.)
- Change drawing attributes
- Edit drawing entity properties (e.g., color, layer, thickness, linetype)
- Construct drawing entities (e.g., offset, timer, extend, break, mirror, etc.)
- Edit drawing entities (e.g., offset, trim, extend, break, mirror, etc.)
- Set system variables (e.g., units, scale)
- Use system variables
- Create layers
- Name layers
- Manipulate layers
- Save files
- Create back-ups
- Create hatches, patterns, symbols
- Recall drawing templates/blocks

Competency: Annotate orthographic drawings

Competency Builders:

- Create text styles
- Edit text styles
- Select text styles
- Apply notes

Competency: Dimension orthographic drawings

Competency Builders:

Create dimensions
 Edit text
 Control dimension variables/models

Competency: Control display

Competency Builders:

Apply view control while drawing (e.g., zoom and pan)
 Control view resolution (e.g., viewers)
 Save views
 Display views

Competency: Extract entity and drawing information

Competency Builders:

Measure distances
 Measure areas
 Identify locations
 List entity characteristics (e.g., length, size, location, properties, etc.)

Unit: Intermediate CADD

Competency: Manage symbols and attributes

Competency Builders:

- Create blocks and W-blocks/templates
- Create nested blocks/templates
- Insert blocks and drawings/templates
- Redefine blocks/templates
- Edit blocks/templates
- Apply attributes

Competency: Create 2-D isometric drawings

Competency Builders:

- Manipulate snap and grid settings
- Toggle planes (e.g., left, right, top)
- Create text styles for each plane
- Create dimension styles
- Use dimension styles
- Create isometric ellipses

Competency: Use external routines

Competency Builders:

- Load AutoLISP programs
- Execute AutoLISP programs
- Load ADS programs
- Execute ADS programs

Competency: Create custom menus**Competency Builders:**

Demonstrate search routines when using a text editor
Write screen menus and macros
Write tablet menus and macros
Write cascading pop-down menus and macros
Write icon menus and macros
Write button menus and macros
Write other customizable CADD files (e.g., ACADD.PCP)
Edit other customizable CADD files (e.g., ACADD.PCP)

Competency: Create script files**Competency Builders:**

Write a slide show script
Write a script for setting initial variable settings
Write a script for creating a title-block

Competency: Create custom linetypes**Competency Builders:**

Formulate a linetype composed of long dashes
Formulate a linetype composed of lines, dashes and dots

Competency: Create 3-D wireframe models**Competency Builders:**

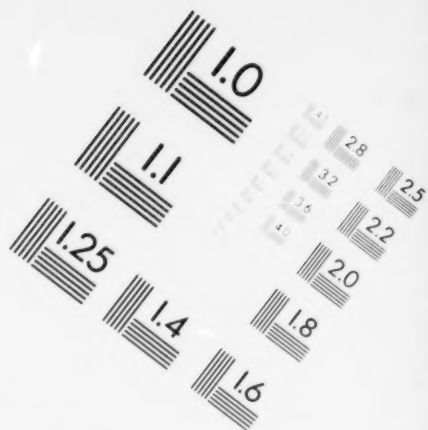
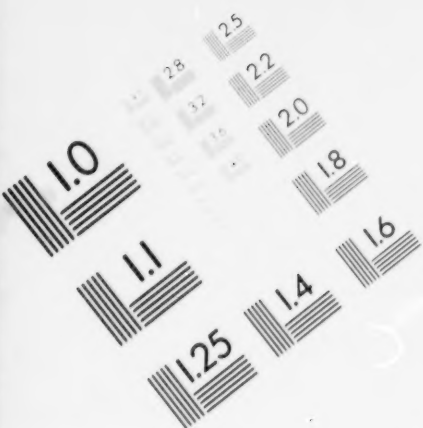
Differentiate among extrusions, wireframes, surface models, and solid models
Create user coordinate systems
Manipulate user coordinate systems
Use cylindrical coordinates
Use spherical coordinates
Use .XYZ filters
Project geometry from one plane to another



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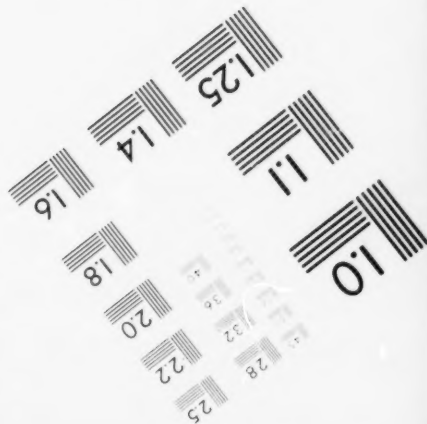
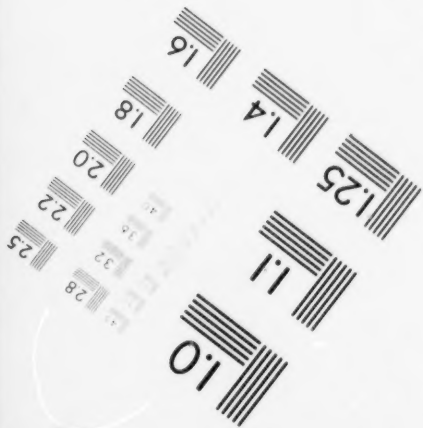
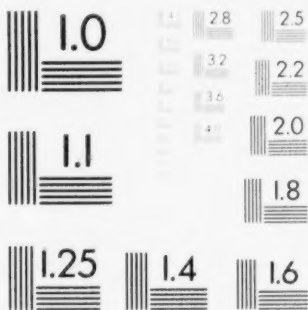
1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910
301/587-8202



Centimeter



Inches



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Competency: Create 3-D surface models

Competency Builders:

Define B-rep surfaces
Differentiate B-rep surfaces and non-uniform rational B-splines (NURB's)
Create tabulated surfaces
Create ruled surfaces
Create revolved surfaces
Create edge surfaces (e.g., coon's patch)
Apply surface meshes to 3-D wireframes
Modify visibility of the edges of faces
Dimension a 3-D model for both isometric and orthographic drawings
Control dimension scale with regard to plotting scale

Competency: Apply advanced control display techniques

Competency Builders:

Define camera viewpoints and angle of rotation
Control display angle (e.g., d-view, v-point)

Unit: Equipment Installation**Competency: Explain installation procedures****Competency Builders:**

Explain relocation procedures for new equipment in an existing facility
Explain the use of anchors and isolators
Explain procedures for moving and installing new equipment
Explain leveling and aligning procedures
Explain test run guidelines
Explain safety precautions for equipment installation procedures
Explain grounding procedures
Explain installation of utilities (e.g., electricity, air, water, drains)

Competency: Prepare for equipment installation**Competency Builders:**

Identify equipment requirements (including safety)
Identify maintenance services needed
Identify method of moving and equipment needed
Identify measuring devices
Calculate weights
Follow manufacturer's specifications and manuals
Identify applicable electrical, mechanical, hydraulic, and/or pneumatic principles
Read drawings/schematics
Revise drawings if applicable
Interpret prints

Competency: Install Equipment

Competency Builders:

Prepare site
 Use measuring devices
 Calculate weight
 Follow manufacturer's specifications
 Use appropriate moving equipment
 Align equipment to layout specifications
 Apply electrical, mechanical, hydraulic, and/or pneumatic principles

Competency: Explain rigging functions

Competency Builders:

Estimate the weight of a load
 Find the center of gravity
 Identify the rigging and slings used in maintenance work
 Explain safety inspection procedures for rigging, ropes, and slings
 Perform safety inspection procedures for rigging, ropes, and slings
 Identify rope fiber types
 Tie rigging knots, bends, and hitches
 Identify types of wire rope
 Cut wire rope assemblies and termination's
 Identify cranes and hoists
 Identify and explain scaffolding types
 Identify safety equipment (e.g., life belts, nets, etc.)

Competency: Perform rigging functions

Competency Builders:

Perform safety inspection procedures for rigging, ropes, and slings
 Tie rigging knots, bends, and hitches
 Cut wire rope
 Seize wire rope
 Install wire rope eyes, sockets, and hooks
 Splice wire rope
 Erect a scaffold
 Rig life belts and nets

Unit: Equipment Maintenance

Competency: Perform housekeeping

Competency Builders:

Dispose of scrap metal chips, shavings, trash and waste
 Clean work area
 Store hand tools, cutters, fixtures, jigs and attachments
 Store grinding wheels
 Follow tool crib procedures
 Inspect machine guards
 Replace or adjust machine guards
 Report problems to supervisor

Competency: Perform recordkeeping

Competency Builders:

Explain reasons for keeping maintenance records
 Explain reasons for keeping cost records
 Complete work order
 Complete internal requisition
 Complete external requisition
 Complete time cards
 Complete job status reports
 Complete equipment failure reports
 Record preventive maintenance activities
 Record repair activities
 Read job orders and process sheets
 Locate tooling and set up information
 File reports
 Prepare new/replacement equipment recommendations

Competency: Inspect machine systems**Competency Builders:**

- Explain planned maintenance
- Explain predictive maintenance measures
- Explain preventive maintenance measures (e.g., lubrication)
- Log machine histories
- Explain machine system(s) calibration
- Inspect linkages and lever mechanisms
- Inspect drive couplings
- Inspect clutches
- Inspect roller ball bearings
- Inspect safety systems
- Analyze system failure
- Make minor adjustments/repairs
- Coordinate maintenance services

Competency: Perform machine maintenance**Competency Builders:**

- Use operator's and manufacturer's manuals
- Operate individual machines
- Diagnose malfunctions
- Apply lockout/tagout procedure
- Disassemble defective section
- Clean equipment
- Lubricate equipment
- Check equipment for wear and alignment
- Repair or replace defective parts
- Test machine for performance
- Make minor adjustments to equipment
- Prepare planned maintenance schedules
- Explain breakdown maintenance

Competency: Maintain hand tools**Competency Builders:**

- Demonstrate use and care of measuring devices (e.g., rules, tapes, calipers, micrometers, multimeter, thermometer, and coordinate measuring system)
- Demonstrate use and care of equipment used to bend and assemble rigid conduit and tubing
- Demonstrate use and care of common hand tools
- Demonstrate use and care of wood working tools (e.g., saws, planes, drills, hammers)
- Demonstrate use and care of sheet metal tools (e.g., sheet metal gauges, hand seamers, soldering irons)
- Demonstrate use and care of ropes, slings, pullers, and block and tackle
- Demonstrate proper metal working bench skills (including use of vices, hacksaws, files, tapes, dies, and reamers)
- Demonstrate use and care of pipe clearing equipment

Competency: Maintain portable power tools**Competency Builders:**

- Demonstrate use and care of light-duty and heavy-duty drills
- Demonstrate use and care of electric hammers
- Demonstrate use and care of pneumatic drills and hammers
- Demonstrate use and care of power screwdrivers and impact wrenches
- Demonstrate use and care of linear motion saws
- Demonstrate use and care of circular saws
- Demonstrate use and care of routers and planes
- Demonstrate use and care of belt, pad and disc sanders
- Demonstrate use and care of grinders and shears
- Demonstrate use and care of explosive actuated tools
- Demonstrate use and care of electric lifts

Competency: Maintain stationary equipment

Competency Builders:

Demonstrate use and care of mechanical presses

Demonstrate use and care of hydraulic presses

Demonstrate use and care of drill presses

Demonstrate use and care of bench grinders

Demonstrate use and care of power saws (e.g., hack, cut-off, chop, band, jig, and table)

Demonstrate use and care of band saws

Demonstrate use and care of pipe threaders

Demonstrate use and care of metal brakes

Demonstrate use and care of power shears

Unit: Electromechanical Technology

Competency: Interpret electromechanical drawings

Competency Builders:

Identify types of drawings and their applications

Transfer measurements

Explain the use of auxiliary views, revolutions, and sectional views

Describe dimensioning practices and techniques on drawings

Interpret mechanical/electronic production and assembly drawings

Competency: Describe the operation of electronic sensors and transducers

Competency Builders:

Explain temperature transducers operation

Explain stress and strain transducers operation

Explain magnetic transducers operation

Explain liquid and fluid flow transducers operation

Explain fiber optic system operation

Competency: Demonstrate proficiency in transducers (sensors) and instrumentation

Competency Builders:

- Describe characteristics associated with transducers and instrumentation
- Describe the principles and operations of various types of transducers (e.g., thermal, shock/vibration, acceleration, positional, pressure, flow, optical, gas and humidity)
- Demonstrate the use of various transducers (e.g., thermal, shock/vibration, acceleration, positional, pressure, flow, optical, gas and humidity)
- Troubleshoot transducers
- Differentiate among thermocouple types
- Interpret specifications of temperature sensors (e.g., thermocouples, thermistors, resistance temperature devices)
- Interpret specification of pressure sensors (e.g., strain gage, piezzo electric/piezzo resistive) to electrical circuits
- Interpret specifications of flow sensors (e.g., orifice flow meter, turbine meter, mass flow meters)
- Interpret specifications of speed or position sensor (e.g., tachometer, resolver encoder, linear voltage differential transformer (LVDT))
- Interpret specifications of controllers, indicators, and recorders (e.g., process controllers, programmable logic controllers with interfaces, R-chart recorders, dataloggers/indicators)
- Interpret specifications of final control elements (i.e., silicon controlled rectifiers (SCR), power controllers, motor drives, actuators/robots)
- Describe application circuits
- Calculate specification of proximity sensors
- Calculate specifications of infrared and photo-sensors
- Explain use of proximity sensors
- Explain use of photo electric sensors
- Explain use of mechanically activated switches
- Troubleshoot switch failure
- Describe transducer control and measurement circuits
- Demonstrate the use of control and measurement circuits
- Troubleshoot control and measurement circuits

Competency: Demonstrate proficiency in power distribution systems

Competency Builders:

- Describe power distribution systems
- Describe poly-phase distribution systems
- Describe single-phase distribution systems
- Describe DC distribution systems
- Describe delta distribution systems
- Describe wye distribution systems
- Describe medium-voltage distribution systems (less than 600v)
- Troubleshoot poly-phase distribution systems
- Troubleshoot single-phase distribution systems
- Troubleshoot DC distribution systems
- Troubleshoot delta distribution systems
- Troubleshoot wye distribution systems
- Troubleshoot medium-voltage distribution systems

Competency: Demonstrate proficiency in power distribution equipment

Competency Builders:

- Describe power transformers
- Describe power capacitors
- Describe power oil switches and cutouts
- Describe application of NEMA or IEC controls
- Describe different types of enclosures for controls
- Describe current transformers
- Describe potential transformers
- Describe medium-voltage circuit breakers and fuses
- Use medium-voltage safety equipment
- Troubleshoot power transformers
- Troubleshoot power capacitors
- Troubleshoot power oil switches and cutouts
- Troubleshoot current transformers
- Troubleshoot potential transformers
- Troubleshoot medium-voltage circuit breakers and fuses

Competency: Demonstrate proficiency in motors and motor control

Competency Builders:

- Test solid state components with ohmmeter
- Test solid state DC motor control circuits
- Test solid state AC motor control circuits
- Calibrate or recalibrate equipment
- Identify SCR and TRIAC AC control circuits
- Explain how load is connected to 3-phase wye configured AC generator
- Identify wye connected and delta connected 3-phase motors
- Explain revolving fields in AC motors
- Describe operation of common AC motors
- Describe operation of variable frequency AC drives
- Define advantages and disadvantages of common DC motors
- Explain how motor load affects speed regulation
- Describe operation of stepper motors
- Describe speed control of various types of motor drives using sensors
- Identify defective motors
- Describe regenerative dynamic breaking
- Describe operation of various feedback loops

Competency: Apply quality control techniques

Competency Builders:

- Perform preventive maintenance
- Perform predictive maintenance
- Apply statistical process control (SPC)
- Recalibrate equipment
- Apply problem-solving tools and techniques

Competency: Apply electromechanical maintenance management practices

Competency Builders:

- Keep maintenance records
- Complete work order
- Complete internal requisition
- Complete external requisition
- Explain planned maintenance
- Explain breakdown maintenance
- Explain predictive maintenance
- Establish maintenance schedules
- Explain reasons for keeping maintenance records
- Explain reasons for keeping cost records
- Analyze system failure
- Make minor adjustments/repairs
- Coordinate maintenance service
- Make new/replacement equipment recommendations
- Interpret bill of materials for allocation, stocking, and raw material information
- Analyze use of bill of materials for workplace decision making

Unit: Hydraulics and Pneumatics

Competency: Describe fluid flow concepts

Competency Builders:

Explain Pascal's Law
 Explain Boyle's Law
 Explain Bernoulli's Principle
 Describe flow velocity
 Explain how heat and pressure relate to power and transmission
 Describe physical and chemical properties of a fluid
 Describe fluids in motion in closed conductors
 Describe continuity of mass flow
 Identify types of fluids
 Identify properties of fluids
 Identify English and metric units of measurement for pressure, density, and viscosity

Competency: Describe energy considerations

Competency Builders:

Differentiate work and power
 Differentiate potential and kinetic energy
 Explain energy conservation concept
 Explain hydraulic horsepower
 Explain work of compression in compressible fluids

Competency: Describe system losses

Competency Builders:

Differentiate turbulent and laminar flow
 Explain friction factor
 Explain pressure losses
 Identify potential system losses (e.g., leaks, wear, component sizing, heat, dirt)

Competency: Describe hydrostatics

Competency Builders:

Explain pressure, density, and viscosity
Explain buoyancy
Explain equilibrium

Competency: Calculate energy

Competency Builders:

Apply Pascal's Law
Apply Bernoulli's Principle
Apply Boyle's Law
Calculate work and power
Calculate potential and kinetic energy
Calculate hydraulic horsepower
Calculate flow velocity and pressure
Calculate pressure losses
Calculate laminar flow
Calculate pump capacity
Calculate system requirements

Competency: Design basic hydraulic/pneumatic system

Competency Builders:

Use common symbols
Create circuit diagrams (i.e., schematics)
Diagram closed-loop hydraulic system
Diagram an air supply system

Competency: Describe component operation

Competency Builders:

Identify functions and operation of hydraulic components
Identify functions and operation of pneumatic components
Explain application(s) of different materials (e.g., plastic, copper)

Competency: Interpret hydraulic and pneumatic schematics

Competency Builders:

- Identify common symbols
- Sketch circuit diagrams (i.e., schematics)
- Interpret circuit diagrams (i.e. schematics)
- Sketch circuit analysis
- Diagram an air supply system

Competency: Troubleshoot hydraulic and pneumatic circuits

Competency Builders:

- Analyze hydraulic circuits
- Troubleshoot hydraulic circuits
- Analyze pneumatic circuits
- Troubleshoot pneumatic circuits

Competency: Perform pump maintenance and repair

Competency Builders:

- Identify types and operating features of pumps
- Identify pump capacity and system requirements
- Explain packing and seal requirements
- Explain operating principles of pumps (e.g., centrifugal, propeller and turbine rotary, metering)
- Perform pump maintenance
- Disassemble a pump
- Reassemble a pump

Competency: Maintain piping and accessories for high and low pressure fluid power systems

Competency Builders:

- Identify components of a piping system
- Explain maintenance features of both metallic and non-metallic piping systems
- Explain types of valves and their operation and maintenance
- Explain use and maintenance of strainers, filters, and traps in piping systems
- Join common fittings
- Join metallic pipe
- Join plastic pipe
- Join copper and steel tubing
- Bend copper and steel tubing
- Cut copper and steel tubing
- Flare tubing

Competency: Maintain hydraulic system components

Competency Builders:

- Install a contaminant removal system
- Maintain a contaminant removal system
- Explain operation and use of heat exchangers
- Identify reservoir requirements
- Compute hose requirements
- Install hydraulic lines
- Select control valves and servo-type valves
- Install control valves and servo-type valves

Competency: Troubleshoot hydraulic systems

Competency Builders:

- Interpret hydraulic schematic
- Identify causes of failure modes
- Connect electrically controlled valves
- Explain hydraulic system troubleshooting techniques
- Repair or replace hydraulic valves
- Repair or replace hydraulic cylinders
- Repair or replace hydraulic pumps and motors
- Install hydraulic components

Competency: Describe reciprocating and rotary air compressors

Competency Builders:

- Explain relationship of force, weight, mass, and density in pneumatic system
- Explain operation of reciprocating compressors
- Explain operation of rotary compressors
- Explain primary and secondary air treatment (e.g., air dryers, lubricating systems)
- Explain operation of compressor valves, cylinders, and motors

Competency: Maintain pneumatic systems

Competency Builders:

- Install pneumatic system components
- Explain pneumatic system maintenance techniques
- Explain pneumatic system troubleshooting procedures
- Isolate faults in air compressors
- Repair or replace air compressors
- Isolate faults in control valves
- Repair or replace control valves
- Isolate faults in air motors
- Repair or replace air motors
- Isolate faults in air dryers
- Repair or replace air dryers
- Maintain proportioning and servo valves

Competency: Troubleshoot pneumatic systems

Competency Builders:

- Interpret pneumatic schematic
- Diagram an air supply system
- Install pneumatic system components
- Explain pneumatic system troubleshooting procedures
- Troubleshoot air compressors
- Troubleshoot pneumatic control valves
- Troubleshoot air motors
- Troubleshoot air dryers

Competency: Maintain vacuum systems

Competency Builders:

Describe characteristics associated with vacuum systems and sub atmospheric pressure

Describe the principles and operation of vacuum gauges

Demonstrate use of vacuum gauges

Repair or replace vacuum gauges

Describe the principles and operation of vacuum pumps

Demonstrate use of vacuum pumps

Repair or replace vacuum pumps

Describe the principles and operation of vacuum controls

Demonstrate use of vacuum controls

Repair or replace vacuum controls

Unit: Programmable Logic Controllers (PLCs)

Competency: Differentiate among process controls

Competency Builders:

Describe characteristics associated with automatic controls

Define proportional control

Define integral control

Define derivative control

Describe advantages of using proportional, integral or derivative control

Describe disadvantages of using proportional, integral or derivative control

Competency: Explain basic operation of PLCs

Competency Builders:

Describe basic applications of PLCs

Identify program symbols and language functions

Describe function of block transfers

Describe operation of timers, counters, and sequences

Describe operation of analog I/O modules

Describe operation of servo motion control

Describe the principles and operation of PLCs

Competency: Demonstrate use of PLCs

Competency Builders:

- Draw block diagram of a PLC
- Define individual blocks of a PLC
- Use operator's and/or manufacturer's manual(s)
- Translate relay logic to logic for a PLC
- Use function of block transfers
- Operate timers, counters and sequencers
- Operate analog I/O modules
- Operate servo motion control
- Install a PLC
- Connect controller to sensors
- Describe test procedures for new installation of a PLC
- Troubleshoot hardware faults on a PLCs
- Use safety interlock
- Describe use of (Graphic Programmable Panel) GPP
- Write a statement and ladder logic program
- Document a statement and ladder logic program
- Use a PLC program
- Troubleshoot a program for a PLC
- Repair a program for a PLC

Competency: Apply robot fundamentals**Competency Builders:**

Describe the operation of robotic work cells
Operate robotic work cells
Troubleshoot robotic work cells
Repair robotic work cells
Classify robots according to industry criteria
Identify robot power drive types
Describe positioning in terms of axis, actuators and coordinate system
Identify types of control systems and sensors
Apply different methods of programming (e.g., teach, off-line)
Write simple programs to exercise robot functions
Join programs to perform full function
Identify principles of robot safety
Describe operation of various sensors used in robot control
Interface sensors to robot
Interface robots
Define open loop and closed loop control
Design a simple automated system to perform manufacturing operation
Identify operation of end-effectors